PUBLIC WORKS

CITY COUNTY STATE

INTERIOR OF FILTER HOUSE, SHOWING DOUBLE ROW OF TANKS, OPERATING GALLERY, AND CONTROLS

IN THIS ISSUE

APRIL 23, 1921

PUBLIC WORKS.

CITY COUNTY STATE

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Improvements in Trenton Water Purification

Rapid sand filters operated with abundant certain supply of home-made coagulant and disinfectant manufactured at an appreciable economy by the alum and chlorine plants recently installed.

The city of Trenton, N. J., derives its water supply, amounting to about 20,000,000 gallons per day for the present population of 120,000, from the Delaware river, which is polluted by sewage from up-stream and has variable and sometimes excessive turbidity due to coal dust held in suspension in time of flood which then makes its color almost black, and to clay eroded from the banks of the stream. Originally a considerable degree of the turbidity was eliminated by somewhat intermittant pumping and by sedimentation in the city reservoir.

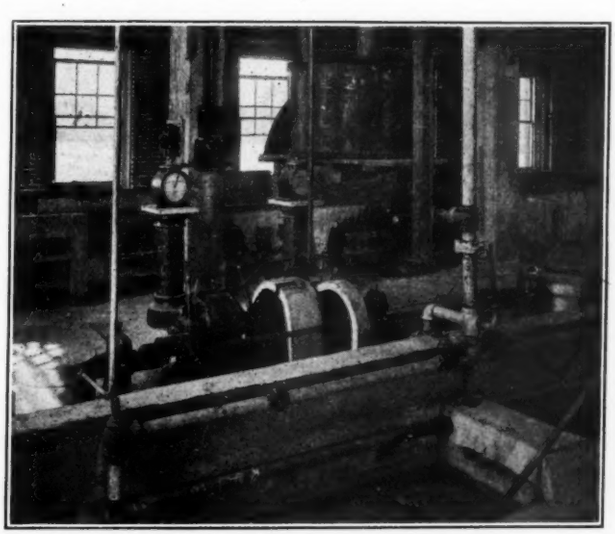
During the ten years ending 1900, the average death rate from typhoid fever in Trenton was 28 per 100,000 population, a mortality which increased in 1910 to 53 per 100,000. This high rate was considerably reduced by sterilizing the water with hypochlorite of lime used as a temporary expedient during the construction of a filtration plant (described in the "Municipal Journal" for October 22, 1914), where the water is purified by rapid sand filters which were designed by Johnson & Fuller and built in 1913 at a cost of about $450,000 under the supervision of F. W. Daggett, now superintendent of the plant.

GENERAL DESCRIPTION

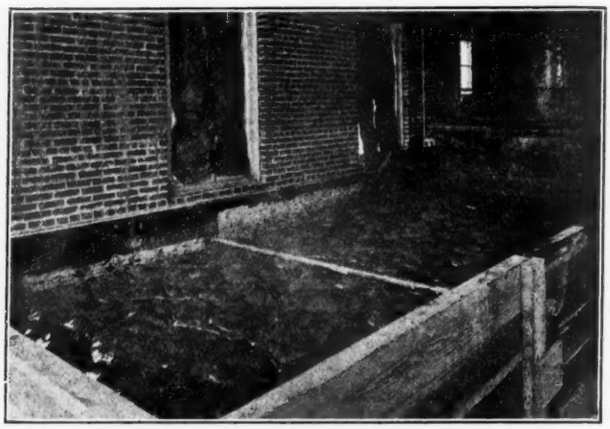
The plant, which has a capacity of 30,000,000 gallons of water per day, consists essentially of two covered sedimentation basins, 16 filters and a clear water basin, a head house, two 60-inch cast iron conduits and complete equipment. There are 2 centrifugal pumps, each of 20,000,000 gallons capacity, directly connected to 125 h. p. direct-current motors, which are automatically controlled by the water level in the sedimentation basin and pump against a maximum head of 25 feet. These pumps are located in the old high-lift station.

There are two 1,800,000-gallon, 210 x 62-foot sedimentation basins, each 18½ feet deep, providing for a 3-hour retention period when the filters are working at full capacity. There are 16 rectangular filter units, each with 652 square feet of sand area, and a capacity of 1,875,000 gallons per day when operating at a rate of 2 gallons per square foot per minute. Under the filters is a 1,200,000-gallon basin with capacity sufficient to supply the high lift pumps for about one hour.

A 40-foot telescopic steel tank, 49 feet in total height, operates like a gasometer to supply air and water under pressure for washing the filters and capacity sufficient for washing two filters at the same time. All of the filters and basins are of reinforced concrete construction and are carried on concrete columns. They are entirely covered by the brick head house and filter house.



APPARATUS BY WHICH CITY MAKES ITS OWN ALUM FOR USE AS COAGULANT



ALUM BOILING BY CHEMICAL REACTION IN THE CRYSTALLIZING TANK

PURIFICATION PROCESS

Raw river water is pumped over distribution and mixing weirs into the sedimentation basin, where the sediment is coagulated by sulphate of alumina applied through lead pipes. After the deposition of the greater part of the coagulated sediment, the water flows over weirs and through hydraulically operated sluice gates to the filter beds, from them passing through the strainer system and registering rate controllers into the clear-water basin, at the outlet of which the filtered water is dosed with chlorine, and is then pumped to the storage reservoir. The filters are of the negative head type and are washed at an average of about 40-hour intervals, requiring about 1.6 per cent of the total water filtered for washing purposes.

As the turbidity varies rapidly at times from a very small amount up to 3,000, and may change from 10 to 200 in 3 hours, the quantity of alum required for coagulating varies correspondingly from about 50 pounds to about 450 pounds per 1,000,000 gallons of water treated. About 2 pounds of chlorine is required for every million gallons of water treated.

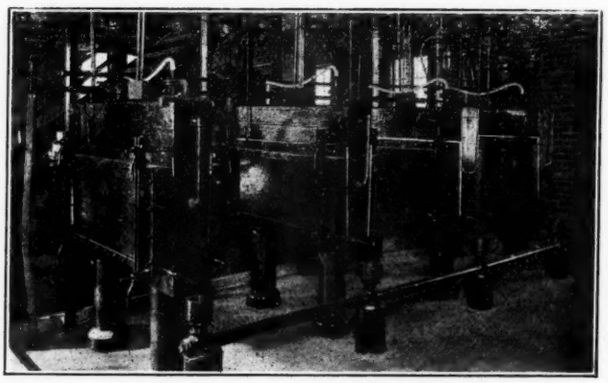
When the filter plant was put into operation, both alum and chlorine were purchased in the open market. During the war the price of alum and of chlorine was so much increased, the supply so much decreased, and the uncertainty of securing them was so great, that it became desirable to manufacture them at the plant, which has been done very successfully, insuring an abundant supply at a less cost than it could be purchased for.

ALUM MANUFACTURING PLANT

In 1918 a $15,000 plant was installed for the production of sulphate of aluminum by the Hoover process, which is essentially a simplification of the usual commercial process, modified so as to avoid the troublesome and expensive process of removing the insoluble silica, which is not considered particularly objectionable for filtration purposes.

Bauxite, the natural ore from which aluminum is made, and which contains about 55 per cent of the oxide of aluminum, is shipped from Arkansas at a cost of about $35 per ton delivered. This bauxite is mechanically mixed in steel tanks with about double its weight of sulphuric acid, and the resulting thick brown liquid is run into a 12 x 12-foot reinforced concrete tank, where very soon the chemical reaction produces furious boiling which lasts about 15 minutes, after which the mass solidifies and in about 24 hours becomes hard, tough and slightly porous and is chipped out in 5-inch lumps by pneumatic hammers.

This lump alum is hauled to the filter plant and placed in 7,000-gallon 12 x 12-foot reinforced concrete tanks, where it is dissolved with 19 times its weight of water in about 12 to 30 hours, according to temperature. During this process the solution is mechanically stirred to hasten the dissolving and to maintain in suspension the insoluble impurities, most of which consist of silica, which forms 12 to 15 per cent of the weight of the alum. The alum solution is used for dosing the water in the sedimentation tanks and requires special treatment in the way of flushing, etc., to prevent the clogging of the apparatus by deposition of silica. Last year 330 tons of alum were produced at an average cost of $28 per ton as compared with an average market price of about $45 per ton for commercial alum. The plant has a capacity of about 10 tons per week when operated by one man.



GENERAL VIEW OF FOUR ALLAN MOORE ELECTROLYTIC CELLS PRODUCING CHLORINE SOLUTION TO DISINFECT FILTERED WATER

CHLORINE PLANT

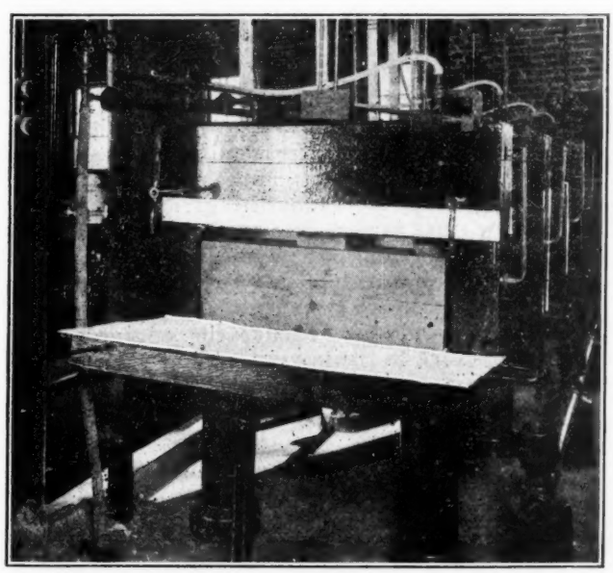
During the war the difficulty and uncertainty of securing chlorine was so great that it was necessary on various occasions to truck it from Philadelphia and other nearby cities, so that it was felt necessary to provide for a certain supply, independent of any possibility of increase or decrease in cost. It is very simply made by the electrical decomposition of brine, producing chlorine gas, caustic soda and hydrogen, the chlorine only being utilized at present, and the other by-products being wasted.

Common salt is placed in a cylindrical concrete tank 6 feet deep and a current of water is passed upward through it. The resulting brine is run over into a 400-gallon tank and soda ash is added to precipitate impurities. After a few days the liquid is pumped through a sand filter into another 400-gallon tank, where it is dosed with a small quantity of muriatic acid. The solution flows into a similar 400-gallon chlorine tank and then into three or four Allan Moore electrolytic

cells of 300 amperes capacity, which will produce 18 pounds of chlorine in 24 hours. The chlorine is pumped out of the cells by a water ejector, and is delivered to the clear-well. It is continually mixed with the filtered water in accurate amounts determined by the variable rate of consumption and by the results of bacterial analyses made from samples taken every 4 hours.

This method entirely eliminates the difficulties of handling chlorine gas, which involves considerable trouble and possible danger when it is purchased commercially in tanks under pressure, since the pressure may be greatly increased by high temperature and the tanks are likely to develop leaks that may be dangerous. The chlorine is manufactured in quantities that are proportioned to the amounts of water being pumped and are determined by the amperage on the cells and the amount of brine delivered to them, which are changed from time to time according to requirements.

The chlorine plant is of simple construction, all tanks being made of reinforced concrete. The total cost of installation was about $4,000 and as the operation requires no additional labor, the cost of production is practically that of the salt and electric current, which in 1920 was about 4½ cents per pound of chlorine produced, while the fixed charges, including interest, depreciation, and other items, amounted to about as much more, making the total cost 9 cents per pound and showing a decided economy over the purchase of chlorine in the market. This advantage was considered, however, to be only incidental because the essential feature was to provide a certainty of supply, and this is now reasonably assured by the facts that salt can always be secured, there is abundance of electric current, and little probability of failure of the electric cells, one of which is always in reserve; and that the process involves no complicated operations and requires no skilled labor and but little attention.



ELECTROLYTIC CHLORINE APPARATUS SHOWING INTERIOR OF 300 AMPERE CELL IN FOREGROUND

Unusual Engineering Construction Data

The construction of the 35 million dollar flood control work in the Miami valley involved problems requiring study and research work of an exhaustive character. The results of these studies were believed to be so valuable that they have been described in a number of unusual technical reports issued by the Miami Conservation District and for sale at the very low cost of from 50 cents to $1 each, excepting an atlas containing 139 drawings for which $1.50 is asked.

The titles of the different books are: Part 1—The Miami Valley and the 1913 Flood. Part 2—History of Miami Flood Control Project. Part 3—Hydraulic Jump and Back-water Curve. Part 4—Calculation of Flow in Open Channels. Part 5—Storm Rainfall of Eastern United States. Part 6—Contract Forms and Specifications. Part 7—Atlas of Selective Contracts and Explanation Drawings to Accompany Part 6. Part 8—Hydraulics of the Miami Flood Project. Part 9—Rainfall and Run-off in the Miami Valley. Part 7 is considered by the publishers to be the most valuable of the series. It presents the methods of determining the type of flood control plans and the methods of working out their applications. If these data had been available when the project was undertaken, it would have saved a great amount of expense and effort.

Gang Vs. Patrol Maintenance in New York

On this subject the state highway commissioner of New York, Fred Stuart Greene, says in his report for 1920:

We are glad to report that the extension of the gang system has proven of greater benefit to the state than our most optimistic expectations led us to hope. For the purpose of judging results, we point to the maintenance work done in one of the divisions of the department, where, during the season of 1920 no patrolmen were employed; all work being done by gangs. For patching, painting of guard rails and similar light work, small gangs of from two to four men were employed, while for the heavy reconstruction work gangs running as high as twenty men were used.

We quote below from a report submitted by the engineer in charge of this division:

"The gang system in this division has demonstrated that there is no comparison with the patrol system in any phase or feature of the work. . . ."

"The gang system which is more mobile always concentrates its efforts on the sections of highways which need repairs; this is not true of patrolmen for the reason that they were appointed to local beats. . . ."

"The real difference between the gang system and the patrol system is that the gang system completes its object and the patrol system never seems to reach it."

We believe that no better proof of the success of the gang system of maintenance can be given than to point to the condition of the highways during 1920. It is admitted that never in the history of road building was it more difficult to secure labor or material than during the past sea-

son, and yet it is stated by farmers, officials of automobile clubs, and by citizens who constantly use the roads that the state's system was never in better condition than during the past summer. We believe that equal results could not have been secured by the patrol system, and that our roads were in such good repair during 1920 was due to the greater efficiency of the gang system. At a meeting of the division engineers, held at the Albany headquarters during October, the gang system was unanimously endorsed and a majority of the engineers stated that in their opinions more work had been done with this system by June 15 of this year than was done all of last year by patrolmen.

Delaware State Road Contract No. 26

Contract 26 of the Delaware State Highway Department, in charge of Charles M. Upham, chief engineer, is for the construction of 5 miles of concrete highway, 18 feet wide, from Hard's Corner to Roger's Corner, south of Wilmington. It involves about 9,700 yards of concrete and 25,000 yards of grading and was awarded to Fisher & Crozza, Baltimore.

Sand, broken stone and cement are received by rail and the cement is stored in two 20 x 40-foot houses parallel to the railroad track and about 15 feet apart, that are united by a loading platform 7 feet high above the surface of the ground, on which the cement, wheeled from both houses, is conveniently dumped into the batch boxes.

Sand and gravel are delivered in carload lots on the siding adjacent to the main track of the railroad and are unloaded by a locomotive crane traveling on a service track between the cement houses and the siding. They are stored in large piles on the surface of the ground, one adjacent to each of the cement storehouses.

The locomotive crane reclaims the stone and sand from the piles and deposits them in 50-yard bins built on the cement shed roof, which slopes in one direction only and is 14 feet high on the lowest side. On the side opposite the locomotive crane the bins are provided with gates and chutes through which the aggregate is delivered to batch boxes loaded in sets of four on motor trucks that haul them to the Koehring mixing machine that follows the Koehring grading machine.

After the concrete has been placed on subgrade between Blaw-Knox steel forms it is finished with a Lakewood finishing machine, covered with earth or sand, and kept wet for 14 days, according to the standard specifications.

Water for the job is pumped by the contractor through a 2-inch line extending the full length of the work and operated by an automatic electrically driven pump.

With an average force of about 20 men, the progress of the work during last summer was about 275 linear feet per 9-hour day and it is expected that the work, which was begun in July and was two-thirds completed last fall, will be finished early this season.

The method of using trucks instead of an industrial railway for transporting the batch boxes to the mixer is made possible by the wide shoulders and excellent shoulder material. The results of this system have been very satisfactory and the overhead charges for plant are considerably less than with the industrial railway system.

Forms of Construction Contracts

Discussion at the New Orleans convention of the Associated General Contractors.

Among the principal points made by the members discussing cost-plus, lump-sum, fixed-fee and other types of contracts at the convention of the Associated General Contractors, the most important were the necessity of different types for different occasions; inclusion of overhead in cost; uniformity; freedom of employment; and injustice of putting undue responsibility on the contractor.

J. Waldo Smith, chief engineer, Board of Water Supply, New York City, saids: "I am against cost-plus contracts in general. I think they can only lead to the grossest favoritism and unfairness, and that they will tend to stifle resourcefulness and inventive ability of contractors, and in the end they would spoil the contracting business.

"I am perfectly willing to admit, however, there is a place for all kinds of cost-plus contracts, as well as lump-sum contracts, because we have conditions arise where work must be done under stress of great emergency, and in such cases such contracts are the only way that work can be done. There are other cases where the plans are incomplete, where it would not be possible for contractors to make intelligent bids, and there are other cases where the elements of doubt and uncertainty are too great a proportion in the whole job to allow of an ordinary form of contract.

"But in general it appears to me that the old form of contract, either the itemized or the lump-sum with full information, is the one that will secure the greatest good for the greatest number.

"I know, just as well as you do, that there has been a tendency for the lawyers, aided by the engineers, to seek to establish forms of contracts in which every form of responsibility is on the contractor. I would not excuse the engineers for their assistance to the lawyers; it's all wrong and can lead to no good, and I am sure it is a practice which you as contractors deprecate fully as much as I do."

A. J. McKenzie, McKenzie Construction Co., San Antonio, said: "It is essential that we have some contract that protects the contractor for the younger architects and engineers to copy. If we can get some organization like this or the American Institute of Architects to prepare a uniform contract that all these young architects and engi-

neers will copy, we are much safer. In San Antonio, for instance, all the architects practically have adopted the standard contract of the American Institute of Architects, but in the engineering work this is not the case and our engineering contracts are very much one-sided.

"It is for this reason that the Texas section of the American Society is attempting to prepare a uniform contract that can be copied as a general rule to apply to most construction work.

"With reference to the forms of contracts, I know of no way of letting public work except by the lump-sum or unit-price methods, it is necessary that we prepare a contract whereby the contractors will be protected against the unscrupulous engineer or architect.

Mr. O'Leary, of New Orleans, said: "I am in favor of a fixed-fee contract. It is possible to get all the benefit if you can make an estimate of your cost and if you will let your fixed fee share in any excess that goes over that to a certain amount. You can get a man struggling just as hard to have that contract come out for the amount you figured it, as if you had a lump-sum contract. It's all right with the fellow that gets the higher result. What we've been up against more than anything else in the lump-sum contract has been the fellow that bids too low—sometimes because he didn't care and sometimes because he had made a mistake. We took these contracts because we needed them to keep our organization together, and we lost.

"If you will let the owner have the benefit of any saving and do him an honest job, then all the time you are aiding the better class of contractors. The results do come out right and if they don't, you share in his loss. I think that is a good form of fixed-fee contract and is a better protection for you than the lump sum and is fair to the owners, too."

Allen J. Krebs, of Atlanta, Ga., said: "After my experience with government work of about eighteen months, I spent many moments in my executive capacity wondering why we didn't get better results, and if it was a question of the integrity of our associates in the general contracting business who were not putting behind it sufficient service, and finally I realized that there was an insidious influence that operated against us and against the owners under the cost-plus system.

"We were exploited by the laboring people and we were exploited by the material people and we had no other recourse, if we wanted to fulfill our obligations, than to accept the circumstances and proceed with the work.

"I believe when the committee prepares these uniform contracts it should furnish us with a contract that will suit cost-plus work and a contract that will suit lump-sum work.

"It is our prerogative as contractors to work on any basis which we think is the proper policy for our firm. Fundamentally any firm that is equipped with brains, experience and that one essential of integrity and honor, can fulfill any contract whether it be of cost-plus system or lump-sum contract, and therefore, as it is our prerogative to work on either basis, I think that this committee should furnish us with a contract guaranteeing to us justice under both systems.

"The same thing applies to your question of labor. It is our prerogative whether we should work a union shop or a closed shop, and on those principles I insist that that be our prerogative as a national association, and when those things are considered in that light where we can operate as men with efficiency and honest purposes, we can continue. As for myself, I am opposed to cost-plus work."

Road Drainage Structures in Giles County

By T. C. McEwen*

This county is thinly settled, and only $3,000 to $4,000 a mile was available for road improvement, but labor is cheap. Therefore, for bridges, local materials—locust and chestnut poles and field stones—were used.

Giles county, on the Alabama border of Tennessee, is hilly, with numerous creeks, branches and steep hillsides, which necessitate more than the usual number of drainage structures. With only $350,000 voted for roads and bridges, giving from $3,000 to $4,000 a mile, and the high price of labor, material and machinery, the writer was handicapped in carrying out any satisfactory construction.

After discussion with the County Highway Commission, it was decided that local labor be employed, since this plan was believed to have many advantages over the contract system on roads of this character. The men living in the community where the road is being built are given employment; they can better discuss road locations, secure rights of way, and select a man of the neighborhood best fitted to act as foreman; and they are directly interested in the road, for they are to use it, and will therefore give more fully of their time and energy in building it.

It was the purpose to use inexpensive machinery and such as could be continued in use in maintaining the roads after completion; also, because of the inexperience of the labor, the simplest of machinery and implements. Six or eight grading machines, a number of slips, hand drills, hammers, shovels and bars were the only tools purchased.

By this method of road building, all of the bond issue money except a small portion for equipment is paid back to the men in the community. This system was inaugurated in August, 1920, when labor was at its highest, receiving 25 cents per hour, and 60 cents was being paid for teams. Since then, however, there has been a reduction to 20 cents for labor and 45 cents for teams. Twenty crews were started to work the first of August, 1920, and up until the present time approximately sixty miles of road has been

*County Engineer; 1st Lt. E. R. C., U. S. A.

graded, graveled and drained. The work has not been carried on continuously, as provisions were made whereby the farmers were allowed to get off when it was necessary to tend crops.

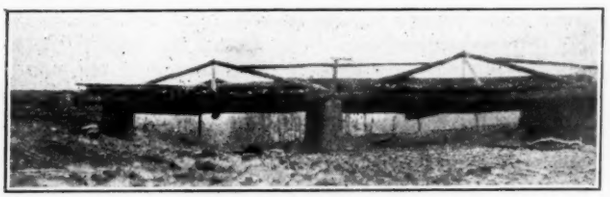
This is an entirely new method of expending bond issues for road construction in Tennessee, and an entirely new one to the writer. Its success has been due entirely to the honor and integrity of the men who were selected to carry on the work. To have contracted these roads it would have been necessary to delay the letting of this work for at least one year while surveys, plans and specifications were being worked out in detail, and the funds available would not have built the type of roads that are now being built. The cost of grading and graveling would be more than doubled. The cost of graveling alone by contract averaged $1 per cubic yard placed and spread on the road. We are now putting this gravel down at an average cost of 75 cents per cubic yard.

DRAINAGE STRUCTURES

The chief purpose of this article is to describe in detail the cheapness of the drainage structures that were used. In order, however, to appreciate why such structures were built, it was necessary to outline the amount of money available, the class of workmen, the materials and tools at hand.

After investigation, it was found that black locust poles and chestnut poles could be obtained very cheap. Also, that locust fence posts were in an excellent state of preservation after being in use for fifty-two years, while a chestnut pole bridge, constructed twenty-eight years ago, and still in use, was examined and the timber was found to be sound and serviceable. It was therefore decided to use chestnut and locust poles for culverts and short-span bridges.

A typical structure of this kind is one across Indian creek. This was made in two 25-foot spans, each consisting of two king trusses, each truss supporting one end of a midway transverse



INDIAN CREEK BRIDGE

floor beam 10-inch diameter and 23 feet long. The bolt supporting the beam is 1¼-inch circular. The trusses were set 14 feet apart in the clear, and were braced by batter posts from the top of the truss to near the end of the floor beam, which extended about 3½ feet beyond each truss. The bottom chord of each truss was a locust pole about 10-inch diameter. The chords of the two spans were lap-spliced and spiked together, forming a continuous stringer.

Resting on one abutment and the pier and on the floor beam at the middle were five locust stringers about 10-inch diameter and 28 feet long. On these stringers 5-inch locust poles were laid close together transversely and spiked to the stringers. On top of these a 10-inch pole was laid against and spiked to the truss on each side to act as a curb, extending the full length of the bridge and retaining the gravel roadway in place. The crevices between the 5-inch poles were filled with broken stone, covered with two inches of clay which acted as a seal to hold the water. On this was placed about 8 inches of creek gravel for the roadway surface.

The material used comprised sixteen 28-foot locust poles costing $58 delivered; 120 5-inch locust poles costing $36; ten 20-foot poles, $20. The end abutments were of dry rubble about 2 feet thick at the top, 2½ at the base, 8 feet high and 16 feet wide, costing $140 by contract with a local farmer. The labor of building the abutments from stone found at the site, and of framing, etc., was $86, four men doing all the work. The total was $340.

At another point a 3 by 3-foot box culvert was built of stones from the site, covered with twenty-five 5-foot locust poles carrying a 20-foot roadway, at a cost of $22.50. A 10-foot culvert was built with dry rubble abutments 6½ feet high, bridged by 12-inch by 18-foot stringers. The two outside poles on each side were drift-bolted together and a curb pole was drift-bolted on top of the outer one, with a space of 20 feet between them for the gravel, which, with broken stone and clay, was placed as described for the bridge. The stone for this culvert was hauled 3½ miles. Five men consumed five days in quarrying the stone and five more in building the culvert. The cost was $150.

CONCLUSION

The life of these structures, I am sure, will exceed twenty years, and figuring the interest on the principle invested in a permanent structure,

GOOD SPRINGS CULVERT—TEN FEET SPAN

you can readily see that you have saved sufficient money to perpetually replace these structures.

The assessed value of this country was $9,000,000 when the bonds were voted, there was a population of something over 30,000, and the area of the county was approximately 600 square miles; so you will readily see that in order for the inhabitants to get the benefit of any road, it would be necessary to distribute this fund over a wide area.

It is hoped that this information will be of some benefit to engineers and road builders who are situated as the writer, and whose funds are so limited that only the cheapest type of a gravel road could be considered.

PUBLIC WORKS

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Road Maintenance Urged by the President

"I know of nothing more shocking than the millions of public funds wasted in improving highways, wasted because there is no policy of maintenance." This quotation from the address of President Harding to Congress on April 12 gives prominent emphasis to a fact which this publication has been asserting in various ways for several years past. Our special highway number of April 16, 1916, was devoted almost exclusively to the subject of highway maintenance. In the editorial in that issue, we stated that "If this amount (the cost of maintaining the highways) is not spent, the maintenance problem soon solves itself—there will be no roads left to maintain." In support of this statement, we cited the instance of one eastern state where, against the advice of the highway department, the legislature made no appropriation for maintenance, but doubled the recommended appropriation for construction, with the result that within two or three years a considerable percentage of the roads already built had to be entirely reconstructed, there being nothing left of them to repair.

As we have said time and again, we consider maintenance even more important than construction; although, of course, where the total annual cost, including both interest and maintenance, can be reduced by reconstruction, this is the proper thing to do. There will be no disputing by engineers of the claim of the President that it is inexcusable waste to spend millions on constructing highways without at the same time or previously making provision for maintaining in good condition not only the highways to be constructed, but those which are already in service.

Present indications are that, if an additional appropriation is made by Congress for federal aid, it will be conditioned on a proper provision by the states for maintaining highways for which aid is granted; and if Congress fails to make an appropriation, this will largely be due to the fact that the states have been so wasteful of the funds already received and so criminally remiss in failing to provide for the maintenance of the roads constructed by aid of the federal funds now practically exhausted.

A Choice of Contract Forms

The discussion in this issue of different forms of engineering construction contracts may be taken as a fair presentation of the views generally held by the men most interested and best qualified to judge of the types of contract suited for important construction work. That their opinions are disinterested is proved by the fact that there are no advocates for the exclusive use of the cost-plus-percentage system that, although admittedly necessary in some occasions, obviously offers advantages for excessive and unfair profit.

The very rational opinion prevails that there should be a choice of two or more types of contracts suited to widely varying conditions and requirements and that there should be as large a degree of uniformity as possible in contract requirements.

Given these conditions, with experienced contractors of a high type fully equipped with plant and resources, and a fair competition with proper supervision, and there is little doubt that construction work will be faithfully and advantageously executed and that each contractor will have every opportunity for reaping considerable reward for his investment, experience and special skill, ingenuity and courage.

Mosquito Extermination Along Highways

The importance of endeavoring to eliminate mosquitos from the vicinity of highways has been pointed out by the United States Public Health Service in a recent bulletin. This bulletin refers to the suggestion of Dr. T. F. Abercrombie, health officer of Georgia, that gangs working on

roads be required to fill up borrow pits, to properly place and construct culverts, clean ditches and attend to such other small, but important, details as will deprive the mosquito of many of her breeding places.

The especial importance of this along highways is due to the fact that, while to transmit malaria ordinarily, an anopheles must first bite someone afflicted with malaria and later find another victim to whom to communicate the malaria germ, a mosquito dwelling along a roadside has an excellent chance to acquire malaria germs from a passing traveler and to find numerous victims for receiving the same coming to her along the road. Thus the opportunity for spreading the disease is very much greater along the roadside than where the mosquito itself must do the traveling. A single malaria patient driving along the ditch-bordered, mosquito-infested road may provide hundreds of the insects with germs which they may pass on to every traveler along that road.

Non-Rigid Bases for Pavements

Under the above title we published an article in the February 5 issue and for illustrating this used several photographs of California pavements. One of these, on page 112, was entitled "Asphaltic Concrete Base in Alameda," the sub-title stating that this was a two-inch asphaltic surface on a three-inch asphaltic concrete base. After the appearance of this article we were informed by someone familiar with the city that the pavement photographed was not of the kind stated, but that if the camera had been pointed in the opposite direction along the same street the description would have applied. We have taken the trouble to verify this statement and find that it is correct, the photographer or someone else having made the mistake. As a matter of fact, the pavement shown is oiled macadam.

Dr. Waddell Honored by the Chinese Government

With reference to the new bridge that the Peking-Hankow Railways have decided to build across the Yellow river, for which bids have been invited in this country and elsewhere, information has been received by the Chinese Legation at Washington that the Chinese government has decided to appoint a commission of four advisers for examining the designs submitted.

One bridge expert is to be chosen from each of four nationalities, namely: American, Belgian, British and French. Dr. J. A. L. Waddell, the well-known American bridge expert of New York, has been selected by the Chinese government to be the American member of this commission. Dr. Waddell has accepted the appointment and will soon proceed to Peking, probably being absent from the United States six or seven months.

Dr. Waddell will be consulted by the Chinese government principally with reference to the new Yellow River bridge. The Chinese government is very much pleased to be able to obtain the valuable services of so well-known a consulting engineer as Dr. Waddell. During his sojourn in China many important matters in connection with railways will be referred to him in order to get the benefit of his expert advice.

Sewage Treatment at Lexington

Our attention has been called to the fact that, in describing the sewage treatment plant at Lexington, Ky., in our issue of March 26, we neglected to give the names of the engineers responsible for the design of the plant. The Solomon-Norcross Company at Atlanta were the engineers for the plant, the design having been made by Mr. Norcross, who is now a member of the firm of Norcross & Keis, of Atlanta.

State Highway Specifications

Most of the state highway departments have made few, if any, changes in their specifications, but there are a few exceptions. Indiana believes its concrete mix was too rich. Iowa has made some important changes in its concrete specification, which are described in full in this article.

During the past few weeks, in endeavoring to secure highway information on certain points from state highway departments, we asked whether any changes were being made in the specifications for the year 1921, and in almost every case we were informed that no changes were being made or that only minor ones were contemplated. That no changes will be made is reported by Rhode Island, Connecticut, New York, Illinois, Alabama, North Dakota and Ohio; Nebraska was revising its specifications last month; Idaho has made only minor changes, mostly in nomenclature; North Carolina has not yet made any definite changes; Missouri will make few if any changes, in Montana changes have not yet been definitely decided upon, in New Hampshire changes are of only a minor nature. Several of the states did not answer this question and it is assumed that no changes are being made.

In Delaware no very radical changes are being made. Due to the uncertainty of the material market the state will not furnish contractors with road building material as it did last year. Some slight changes are being made in the specifications relative to the details of finishing and curing concrete pavements, but these had not been finally decided upon.

In Indiana the most important change is one of the composition of the concrete in pavements. Under the 1919 Specifications, the mix was a 1:1½:3 with a minimum of 1.91 barrels of cement to the cubic yard of concrete in place. Under the 1920 Specifications, the mix is a 1:2:3 with a minimum of 1.70 barrels to the cubic yard of concrete in place. The 1:1½:3 mix was found to be too rich. Also all concrete pavement is to be

machine finished, and forms shall be according to the following:

Forms. The outside forms for the concrete shall be of steel, having a top flange not less than two and one-quarter (2¼) inches wide. They shall be straight and rigid, of a height equal to the thickness of the pavement at the edge, and shall conform to the following requirements:

Weight of Finishing Machine	*Bottom Bearing Area per Lineal Foot*	*Wt. per Lin. Ft. of Rail Only*
3,000 lbs. or under	39 Sq. Inches	6.5 lbs.
3,000 to 4,000 lbs.	48 Sq. Inches	8.0 lbs.
4,000 lbs. and over	54 Sq. Inches	9.0 lbs.

The forms shall be staked at intervals of not more than five feet and by such means as will maintain the required alignment and grade with exactness. The stakes must be so driven as not to interfere with finishing operations. The contractor shall provide sufficient forms so that it will not be necessary to remove them within twelve hours after the concrete is placed. Before concrete is deposited against the forms, they shall be cleaned thoroughly and oiled.

Pennsylvania has issued seven typewritten pages giving the principal changes in the specifications, most of them for explaining or more clearly expressing statements of the 1920 specifications rather than changing the ideas. These changes have to do with general provisions such as the contractor's responsibility for the work, annulment of contract, progress payments, handling materials, and measuring devices; also expansion joint fillers and transverse expansion joints in concrete pavements, and description of the reinforcing materials to be used in such pavements; in connection with sheet asphalt pavements, the penetration of the asphalt cement has been changed, as has also the temperature of the completed mixture, and certain changes have been made in the details of construction. Various changes in details have been made in connection with asphaltic concrete, warrenite and amiesite pavements. Other changes have to do with pipe culverts and wooden railings, most of these being unimportant modifications or explanations.

IOWA SPECIFICATIONS

The Iowa state department has changed its specifications in several minor respects and one rather important one, in that its "type B" pavement, instead of consisting of "two courses of concrete, a base course and a wearing course," this year consists of "a single course of concrete of the full depth of the pavement with a wearing course of abrasion resisting stone forced into the surface of the concrete and made a part thereof." In connection with this change, it is required that the coarse aggregate for the wearing course of "type B" pavement "shall consist of clean, sound crushed trap rock, quartzite, granite, or gravel pebbles. This aggregate shall contain not more than 15 per cent of limestone, sandstone or other similar soft material. Such limestone, sandstone or similar soft material shall have a French co-efficient of wear of not less than 8. The soft or partially disintegrated particles shall not exceed 2½ per cent. It shall contain no slate, shale, coal or other materials which easily disintegrate, and shall be free from frozen lumps, sticks, flat and elongated pebbles, and vegetable or other deleterious material. It shall pass, when dry, a screen having 2½-inch openings and not more than 10 per cent shall pass an opening of one inch."

Also, instead of finishing "type B" pavement in the same way as "type A": "In the case of 'type B' concrete pavement, after the concrete has been deposited, the surface shall be struck off in the manner described above for 'type A' hand-tamped pavements, and made true to grade and cross-section. The course of abrasion-resisting stone shall then immediately be cast upon the surface of the concrete in an amount sufficient to completely cover same. This stone shall be forced into the surface of the concrete and made a part thereof and the whole mass thoroughly compacted by means of any mechanical device or appliance which will force out the excess water and will leave the course of abrasion-resisting stone embedded in mortar and parallel to the finished surface of the pavement. Any excess mortar shall be uniformly spread over the entire surface. Before the concrete obtains its initial set, the surface shall be belted. This belting shall be of short, rapid transverse strokes having a sweeping longitudinal motion. The belt shall be worked back and forth across the pavement until a uniform surface of gritty texture is secured. The belt must not be over three-ply and not more than 5 inches wide. Badly worn belts must be discarded and new ones supplied."

There is also the additional requirement this year that "In both 'type A' and 'type B' pavement, whether hand or machine finished, after the final belting an edging tool shall be used along the side forms, and the edges of the pavement completed in a finished and workmanlike manner."

The other changes in the concrete specifications are as follows: For coarse aggregate it is permissible to use either crushed trap, quartzite or granite, or screened and washed gravel, or crushed limestone. Last year each of these was required to have a French co-efficient of wear of not less than 8, but this year the gravel is specified to have a co-efficient of not less than 7; and the same is required for the limestone also and it is additionally specified that it "shall not contain more than 5 per cent of material having a French co-efficient as low as 5," while last year the specifications called for not more than 15 per cent with a co-efficient as low as 6.

Last year shale was prohibited in the aggregate, but this year it is specified that "the coarse aggregate may contain not more than 0.5 per cent of shale pebbles if, in the opinion of the engineer, such pebbles are not of an especially injurious nature." Also the amount of coarse aggregate retained on screens with 0.185-inch openings is 95 this year as against 96 last. Provision is made for using unscreened gravel, but all the particles must be clean and sound and those passing a screen with 0.185-inch openings shall conform to the requirements for fine aggregate and that portion retained on such screen shall conform to the requirements for coarse aggregate.

In selecting coarse aggregate for "type B" concrete pavement this must meet the requirements for coarse aggregate for "type A" pavement, except that, if it does not meet the requirements as to French co-efficient of wear, it may be accepted if concrete made from a representative sample in

the proportion 1:2:4 develops an average crushing strength at the end of 28 days of 2,500 pounds per square inch.

A new provision is that for the proportioning of cement to unscreened gravel used for either type of pavement, a table being given showing the ratio of cement to aggregate by weight, this varying with the percentage of fine aggregate in the unscreened gravel. When this is 33 per cent, the ratio of cement to unscreened gravel is to be 1:5.18. When between this and 40 per cent, the ratio is 1:4.84, and ratios are given for each successive interval of 5 per cent up to a ratio of 1:1.87 when the aggregate is more than 95 per cent sand. This gives from 1.6 barrels of cement per cubic yard in the first case to 3.13 barrels in the last. Last year the specifications prohibited crusher run of stone or bank run gravel "unless specifically authorized in the special provisions."

A few changes are made in the construction specifications. Last year it was specified that if the amount of cement used in any three adjacent blocks is less by more than 4 per cent, or if the amount in any one block is less by more than 7½ per cent of the amount required, the contractor must remove the blocks and reconstruct them. This year, if such condition is found, "the engineer shall at once check up the proportioning and satisfy himself that the ratio of cement to fine and coarse aggregate is in strict accordance with these specifications."

The slump test for consistency last year required that a truncated cone with a 4-inch top diameter and 8-inch bottom and 12 inches high should not slump more than 2 inches when a mechanical finishing machine is used nor 4 inches when the finishing is done by some other approved method; while this year the slump is limited to one inch and 2 inches, respectively. Last year it was required that if hand tamping be used, "at least 4 men shall be engaged at the exclusive work of tamping the concrete," while this year it is provided that the tamping "shall meet with the approval of the engineer." An additional requirement this year is that "the placing of loads or piles of fine or coarse aggregates directly upon the sub-grade or upon the shoulders immediately adjacent thereto to be wheeled, shoveled or conveyed directly to the mixer, will not be permitted. Driving or hauling upon piles or fine or coarse aggregate will not be permitted."

$51,000,000 Provided for Baltimore Municipal Construction

There is now available for engineering construction, extensions and improvements in the city of Baltimore $51,000,000 which will probably be expended within the next three years.

Among the principal improvements contemplated is raising 50 feet the present concrete dam of the Gunpowder river water supply. This work will be a simple concreting job involving few special features except the waterproofing of the joints with the offsets in the old structure, and the construction of a seepage gallery to supplement the one already installed. It is expected that the work will cost in the neighborhood of $500,000.

About $4,500,000 more is required for completing other water supply improvements and developments.

The area within the city limits has been extended from about 33 square miles in 1918 to 90 square miles at the present date. This extension has involved the acquisition of one large independent water supply and several small ones, some of which may be abandoned and the others incorporated in the distribution system.

The question of metering the water supply to consumers should be presented in an active campaign that, if successful, will postpone the construction of an extensive and costly filtration plant that will otherwise have to be commenced within a year. It is estimated that about 160,000 meters should be installed at a total cost of about $2,500,000.

About $8,000,000 is required for extension of brick and concrete storm sewers and vitrified house sewers. About $7,000,000 is required for new school houses, $2,000,000 for the extension of conduits, $10,000,000 for harbor development and construction, $11,000,000 for paving, chiefly asphalt, and $1,250,000 for possible filtration plant.

Short-Span Highway Bridges*

Materials in common use. Designing and constructing steel bridges, concrete arches and concrete girders. Maintaining bridges.

MATERIALS

Superstructures may be built of wood, stone, brick, concrete, reinforced concrete, cast iron or steel, or of a combination of these materials. The former extensive use in this country of wrought iron or cast iron for arches, or of combinations of cast iron and wrought iron, and wrought iron and wood, are almost entirely superseded by steel or concrete or reinforced concrete. Wood was also formerly used for arches and girders, but on account of its rapidly increasing cost and scarcity, and because of its limited strength and durability, its use is rapidly diminishing and is now almost entirely confined to temporary structures and short girder spans generally supported on pile trestles, except in very inaccessible regions where timber is still abundant and freight on iron and steel are excessive.

Wood is still used extensively for floor planks, especially on movable spans, and for fixed spans in rural districts. Cast iron is now rarely used, except in a supplemental way, as for bearings, railings and ornamental purposes. The largest amount of highway bridge work in this country is built with steel or reinforced concrete or with a combination of these. Steel is lighter, can be

* *Continued from page* 316.

more exactly proportioned, is less liable to be of poor quality and workmanship and can be most quickly erected. Concrete, on the other hand, usually possesses a larger factor of strength and durability, requires less maintenance and is more readily adapted to artistic and architectural effects.

STEEL SPANS

All movable spans are of steel, and steel may be used for arches, truss spans and girder spans as well as for the piers or columns which support them. Movable spans are sometimes displaced horizontally in a direction parallel or diagonal to their axis, in which case they are called retractile spans. These, however, are infrequent, and movable spans are generally made to revolve in a horizontal plane, when they are called draw spans; or in vertical plane, when they are called bascules. Or they may be built to rise and fall vertically, and are then called lift bridges. In any case, movable spans require very reliable, immovable supports and considerable costly operating mechanism.

Formerly swing bridges were most used, but now the bascule type is in general favor. Any kind of floor may be used with the swing and lift bridges, but a special provision must be made for bascule bridges to retain the floor when the bridge is in a vertical or inclined position, therefore brick and block pavements are seldom used on them and plank floors are frequently adopted, although steel or reinforced concrete may be used. When movable spans are used they are, if possible, located symmetrically or in the center of the structure and generally have monumental piers or architecturally treated features at the ends or centers of the spans.

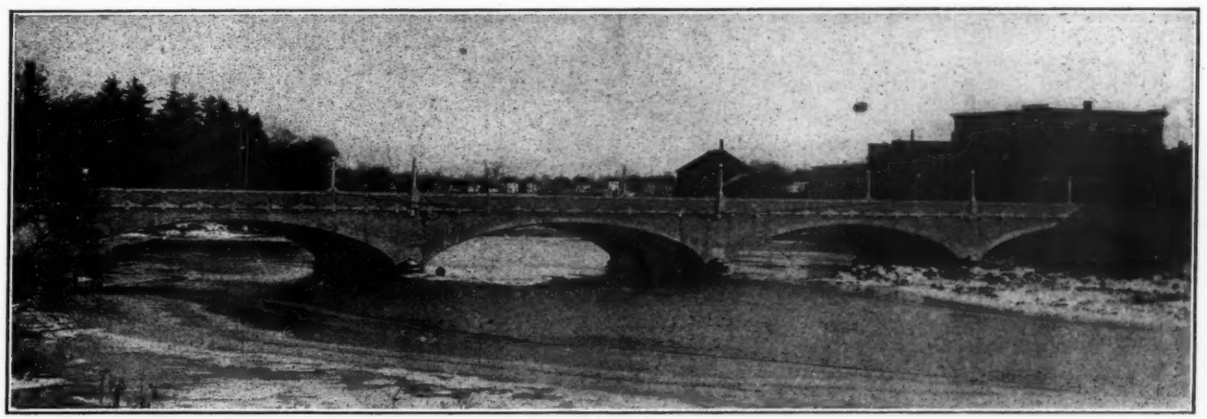
Steel spans may be of deck or through types and may have trussed arches, spandrel braced arches, or they may have either simple or cantilever trusses or girders. Girders are most suitable and economical for short spans, while arch trusses are apt to be the most attractive and present the most artistic appearance for longer spans. The arch spans may be without hinges, with two hinges or with three hinges, and are most advantageously adopted when they can be supported directly from solid rock foundations at both ends.

Simple trussed spans have usually horizontal bottom chords and may have either horizontal or inclined top chords. The different members may have field or shop riveted joints or be pin connected, the former system being now considered more desirable. Other things being equal, the deck type is more simple and economical, but of course, requires sufficient head room below, and often cannot be used because of the limiting elevation of the roadway.

Plate girder bridges may either have riveted girders or be made with single heavy rolled type girders. They are simpler and more rigid but weigh more than the trussed girders. Plate girders are usually used for short spans, although they are practicable for length up to 100 feet, and where the depth is limited for deck spans, as where an extreme minimum of underneath clearance is available for deck girder spans, they are sometimes made of the cantilever type, with a shallow center span suspended from the two arms, thus requiring the least possible depth of longitudinal girder at the center of the span. The principal advantages of girder spans are their simplicity, durability, and the fact that they can be entirely fabricated at the shop, shipped to the site, and erected as units for small spans and as complete girders for the larger spans, thus involving a minimum of time and labor in the field.

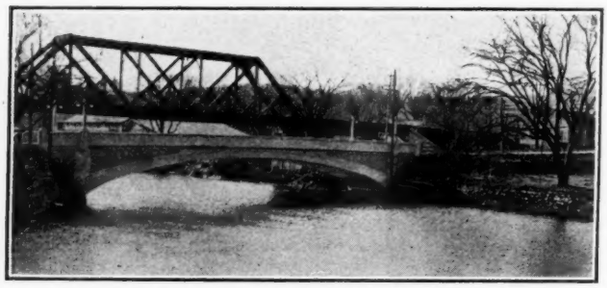
The larger spans are generally used for crossing over depressed railroad tracks. It is difficult to apply artistic or architectural treatment to relieve severity and angularity of their outline. They are often enclosed completely in concrete, especially when it is necessary to protect them from gases and corrosion, and sometimes to facilitate their architectural treatment. All kinds of steel bridge spans can be constructed without difficulty to give absolute security for any given condition of loading, but they generally possess very little excess strength above the specified requirements.

Constructing Steel Girder Spans. Steel girders are generally shipped in sections or as separate members and are assembled at the site on wooden falsework, or are placed immediately on the per-



BRIDGE AT MASSENA, N. Y.

Four 80-foot spans with 30-foot roadway and two 7-foot sidewalks. Built in 1918 at a cost of $68,000, Concrete Steel Engineering Co.



BRIDGE AT GREENWICH, N. Y.
120-foot Melan arch concrete span built in 1916, cost $15,000.

manent sub-structure. The steel is handled in the field by derricks, locomotive cranes, gantry cranes or travelers, such as are used by railroad bridge erectors. These spans can often, if necessary, be erected complete, ready for use, adjacent to the old structure where the latter is still in service, and then the old and the new spans can be simultaneously moved until the new one takes the place of the old one and immediately receives the traffic, while the old one is dismantled at leisure. Under favorable circumstances a steel span of 100 feet can be erected within 4 or 5 days after the steel is all received at the site.

Complete spans or girders may be delivered on flat cars on existing tracks, unloaded and lowered to position by jacking without requiring any special apparatus. When the sub-structure is ready, existing spans of 50 or 75 feet may be displaced and a new one put in place and ready for service in a minimum time of 3 hours after all preparations have been made. They thus involve a very short interruption to traffic.

CONCRETE ARCHES

The use of concrete and reinforced concrete arches for highway spans has increased enormously within the last few years and they will probably eventually supplant other types in a very large percentage of all spans between 30 and 160 feet in length. Within generous limits they may have any required dimensions and lend themselves very readily to a wide range of architectural and artistic treatment and embellishment at a moderate increase over the minimum cost. The concrete may be made monumental in character and consistent with high class surroundings so as to have features in keeping with the suburbs and landscapes.

They almost invariably possess a large excess of strength without materially increasing the minimum cost of construction. They are very durable and require little or no maintenance. They are not, however, articles of manufacture, cannot be fabricated in factories, purchased complete, or shipped from place to place, but should always be designed specially for each given site by competent engineers and built by experienced contractors. They require larger piers and more secure foundations than are indispensable for steel bridges, and cannot be as quickly erected and opened for travel. They cannot be shifted from place to place, and cannot readily be reconstructed. They require considerable height between water level and the top of the floor and are not adapted for supporting a through roadway.

Construction. The construction of the substructure generally requires derricks or their equivalent, and a complete concrete storage, mixing and distributing plant. For work below the water level, sheet piling, cribs, cofferdams and pumping equipment are often required. Operations are generally simple and can be executed by any organization and equipment for ordinary engineering construction and foundation work.

BRIDGE AT CLARKS MILLS, N. Y.
Three Melan rib 86-foot arch spans, 20-foot roadway, no sidewalks. Built in 1916 cost $17,000, Concrete Steel Engineering Co.

The same plant that is installed for the substructure is usually suitable for a large part of the construction of the superstructure of concrete or reinforced concrete arch spans. As for the sub-structure, the concrete may be distributed by service tracks on the new structure, or on an adjacent old one, or on falsework trestles alongside, by derricks or by cables. The arch forms require support on strong and rigid centers and these may either be made with pile and trestle falsework or with movable trussed centers, generally built of steel for spans in excess of 40 feet.

The arch rings are usually built in successive sections corresponding to the voussoirs of masonry arches, and the form work is comparable with the work of any other heavy concrete construction. There is abundant field for ingenuities and economies in design and handling the concrete plants. Competent specialists are available for designing structures and the construction plants and the equipment can be purchased from experienced manufactures that specialize in its production and can furnish it more

cheaply and satisfactorily than the owner can otherwise provide it.

Concrete arch bridges invariably have either solid fill or concrete floors, the latter sometimes being carried wholly or in part by steel floor beams encased in concrete. Sometimes concrete arch bridges are provided with reinforced concrete floors carried by steel beams and girders.

CONCRETE GIRDER AND SLAB SPANS

Spans up to 20 or 30 feet, or sometimes even longer, may be made with reinforced concrete longitudinal girders supporting reinforced transverse beams, or concrete floor slabs, all forming a monolithic structure. During construction the forms must be supported on heavy falsework, generally trestle or pile bents, and the concrete should be delivered in a continuous operation until the entire structure is finished, excepting perhaps that hand rails, as in other structures, may be independent members, pre-cast or cast-in-place, or both, as convenient.

Girder spans are seldom as attractive in appearance as arch spans, but can be used where there is less clearance or in cases of minimum height underneath. Where artistic appearance is not imperative, as for instance, in a manufacturing locality, over railroad tracks and over canals, where there is no landscape to consider, they may be cheaper and more economical than arch spans.

For short spans, up to a maximum of 15 or 20 feet, pre-cast or reinforced concrete slabs may sometimes be used to advantage. They can be supported on solid piers or abutments or on trestle bents, the latter being sometimes also pre-cast and erected as separate and independent pieces. In some cases expert skill is necessary for designing the field connections and the joints between different members.

The principal advantages of these pre-cast spans are that they can be erected with considerable rapidity and be ready for immediate service as soon as the erection is completed and considerable economy can be effected by casting them all on the surface of the ground in the contractor's yard. The floor slabs are usually cast in comparatively narrow, long, longitudinal units, two, three or four of which are required to complete the full width of roadway. They may be cast in tiers, allowed to season as long as desired, transported on special or ordinary flat cars, and loaded, unloaded and erected by derrick cars, locomotive cranes, derricks or special gantries or travelers that handle them rapidly and can be advanced as the work progresses, especially if the structure consists of a number of consecutive spans.

MAINTENANCE

All bridges should be periodically inspected and formal reports filed by competent engineers. Occasionally they require special investigation or testing. Repairs should be well maintained, although important ones should not be required for concrete bridges. Repairs on concrete bridges should hardly exceed the necessary maintenance of the roadway and pointing up of temperature or settlement cracks, which are difficult to prevent and which may not at all impair the integrity of the structure.

Steel bridges of all types require thorough inspection at least once or twice a year, and should be carefully protected against overload. The condition of bearings and riveted joints and the adjustments of adjustable members must be carefully observed and great care should be taken to determine the exact conditions of the floor and the principal floor connections to detect any indications of rust, loose rivets, displacements, or settlement of the structure. The bridge should be thoroughly cleaned and painted as often as the paint shows serious deterioration, which may, under unfavorable conditions, be every few months. Especial care should be taken to prevent the collection of water, snow or ice in any cavity or depression, and to protect the under side of the bridge from locomotive blasts beneath it. For this purpose wooden shields are often used.

BRIDGE AT MINELLO, N. Y.
One 90-foot, one 100-foot and one 110-foot concrete Melan arch span and steel span over barge canel. Built in 1917 at a cost of $60,000, Concrete Steel Engineering Co.

BLACK RIVER BRIDGE, WATERTOWN, N. Y.
BRIDGE AT MINETTO, N. Y.

Liability of Municipality for Nuisance in Garbage Disposal

By John Simpson

Decisions of various state courts. All hold municipality liable for nuisance, whether or not it is acting in governmental capacity. Decisions differ as to liability of city for nuisance created by contractors for garbage disposal. Positive proof of nuisance required.

In some jurisdictions the creation, maintenance and operation of dumping grounds by municipalities is held to be a governmental duty precluding recovery for negligence in connection therewith, where no nuisance to adjoining owners is created. In other jurisdictions, on the contrary, it is held that the municipality in disposing of its garbage in this manner acts in a private and corporate capacity. In either case the weight of authority is to effect that a municipality cannot without liability create a nuisance by the operation of a dump. This article and the cases cited deal only with the maintenance of a dumping ground, and not with the analagous questions of liability for the pollution of streams by sewage or negligence in the carrying away of garbage.

Although municipal authorities may have plenary power in the matter of collection, removal and disposition of garbage, yet they may not lawfully create in connection therewith a nuisance dangerous to health or life; and where such a nuisance is created and its effect is specially injurious to an individual by reason of its proximity to his home, he has an action for damages. Kea v. City of Dublin, 145 Ga. 511; City of Dublin v. Kea, 20 Ga. App. 718; City of New Albany v. Slider, 21 Ind. App. 392; City of Haskell v. Webb (Tex.), 140 S. W. 125; City of Newcastle v. Harvey, 54 Ind. App. 243; New Albany v. Armstrong, 22 Ind. App. 15; and, when necessary and proper, a court of equity will, at the instance of a citizen suffering special injury from the nuisance, enjoin its maintenance. Bell v. Savannah, 139 Ga. 298, where the city garbage dump was maintained near a thickly settled part of the city, and equipped with railroad tracks, on which cars were left standing all day wholly or partially loaded with garbage.

In Taylor v. Baltimore, 130 Md. 133, it was held that chapter 349 of the Acts of 1904, authorizing the City of Baltimore to erect, and operate and maintain a sewerage disposal and filtration plant extending out into the counties, does not authorize the city authorities to create a nuisance; and if, in the operation of the plant, a nuisance is created, the city is liable to those whose property is injured.

The gathering up off the streets and the premises of private persons of garbage, filth and the like, the accumulation of which would menace the public health, is a governmental duty, and when the city authorities assume to discharge such duty, the corporation is not liable for the negligence of its servants in so doing. But this statement must be qualified to the effect that although in the discharge of a governmental duty it must not commit a nuisance. City of Nashville v. Mason, 137 Tenn. 169. In City of Denver v. Porter, 61 C. C. A. 168, 126 Fed. 288, it was held that "the collection of the refuse or waste material of a city, and the deposit thereof in suitable localities by or under the direction of its agents or representatives, is in the exercise of a proper municipal function. A disposition of the constant accumulation of such materials is not only lawful, but also necessary to the convenience of the public." The maintenance of a public dump on land leased for the purpose from a private owner is not in itself a nuisance. But the establishment, maintenance and operation of dumping grounds for the disposal of refuse, under the direction of officers of the city health department, was held to be a duty of local or municipal concern, not performed in the exercise of any governmental function; and that the city was liable for the negligence of its officers and agents engaged in the performance of the work.

The unsightly appearance of an adjacent lot by the dumping of rubbish thereon is not a cause entitling a landowner to damages. Unless there is injury by gases or something else coming from the city lot on to his premises, he has no right to complain. Lane v. Concord, 70 N. H. 485. But a municipal corporation is liable in damages for injury to real estate where the occupancy thereof is rendered less desirable because of noisome odors emitted from an incinerator plant erected and operated by the municipality near to such real estate, and because of the deposit thereon of ashes and other offensive substances by the incinerator plant. Keene v. City of Huntington, 79 W. Va. 713. A municipal corporation which maintains a rubbish dump in which fire is permitted to smoulder for a long time is liable as for a nuisance to the owner of adjacent property destroyed by fire blown by a high wind from the dump. City of Nashville v. Mason, 137 Tenn. 169. See also City of Denver v. Porter, 126 Fed. 288. It is not necessarily, nor prima facie, an act of nuisance to cast the garbage of a city upon Lake Michigan, fifteen miles from the shore. Kuehn v. City of Milwaukee, 92 Wis. 263.

A city will not ordinarily be liable for the acts of an independent contractor, to whom it has given a contract for the removal of garbage. Where the contract does not reserve to the city the right to control the mode or the manner of its performance or the place where the garbage should be dumped. Kuehn v. City of Milwaukee, 92 Wis. 263. But in Flannagan v. Bloomington, 156 Ill. App. 102, it was held that the fact that a city may have employed an independent contractor to remove garbage and refuse matter from the streets and that he, under his contract, used a place as a dumping ground to the injury of adjacent private property without authority or direction from the city to do so, did

not affect the liability of the city for his actions in carrying out a contract with the city in the execution of the power given to the city to remove and dispose of garbage and refuse matter from the streets.

It has been held, though not necessary for the decision of the case, that if the commissioners of public works had done the work of removing and dumping garbage by their own employees and servants, without the intervention of an independent contractor, the city would not have been liable for an injury growing out of the acts of such employees or servants, for it is a public service, as distinguished from a corporate duty; and that the suggestion that a municipal corporation has no right to create or maintain a nuisance was altogether beside the question involved, because it was not the city, but a larger public, for whom the questionable act was done. Kuehn v. City of Milwaukee, 92 Wis. 263.

The Kentucky Court of Appeals holds, City of Georgetown v. Ammerman, 143 Ky. 209, that a board of health has no power to authorize a city, nor has a city any power to order to be dumped or to dump garbage or other refuse matter so that it will wash into a spring used by the people of the city, or that will create a stench to those persons residing in the vicinity thereof. And in Louisville v. Hehemann, 161 Ky. 523, 171 S. W. 165, the same court holds that notwithstanding a municipality is not liable for its agents' negligence in disposing of garbage, this being the discharge of a governmental function, the municipality is liable for the depreciation in value of adjoining property by permitting its dumping ground to become a nuisance.

In Texas it is held that the construction and operation of a city sewage disposal plant by a city is done in its corporate character for the peculiar advantage of its own inhabitants, and the city will be liable for its torts in that respect, as distinguished from its acts done in the interest of the public at large. Brewster v. City of Forney, (Tex.) 196 S. W. 636. And even where the establishment of a dump yard was held to be a public and not a corporate duty, the municipality would be liable if it negligently permitted the dump to become a nuisance. Ft. Worth v. Crawford, 64 Tex. 202, 74 Tex. 404, or even, it has been held, irrespective of negligence. City of Coleman v. Price, 54 Tex. Civ. App. 39.

But the existence of offensive odors, etc., complained of must appear from the evidence, and as having been caused by the operation of the plant. So, in an action against a city for damages from the discharge from the city's septic tank, it was held proper to refuse a requested special issue in the following words: "Did the filth, stagnant water, flies, any or all of these causes coming from the branch as the result of the defendant's sewage emptying therein and flowing down, in, and around plaintiff's residence, cause him or any of the children to become sick or lose their health?" because it assumed the existence in and around the plaintiff's residence of filth, offensive odors, etc., as the result of the operation of the plant. Brewster v. City of Forney (Tex.), 196 S. W. 636.

If a city, by its ordinance, leaves the place and manner of depositing its garbage to its marshal, or other official, it will be responsible for a negligent performance of the duties thus conferred upon him. So, where a city ordinance provided: "It shall be the duty of the marshal to cause the removal and burial, at the expense of the city, of all carcasses of dead animals the owner or person in charge of which cannot be ascertained," it was held, City of Hillsboro v. Ivey, 1 Tex. Civ. App. 653, that this confided the manner of the performance of the duty to the marshal and the city would be liable in damages for his negligent performance thereof in depositing such carcasses so near a private residence as to create a nuisance thereby.

It does not affect the city's liability that the place where the nuisance is caused by a garbage dump is beyond the city limits. If as a fact it bought land adjacent to a plaintiff's premises upon which to dump its garbage, dead animals and other matter, and so used it, and thereby created a nuisance hurtful and injurious to the plaintiff and his property, its liability would result as if the grounds were situated within the corporate limits. City of Coleman v. Price, 54 Tex. Civ. App. 39.

And where the city scavenger, entrusted by the city with the removal of dead animals, garbage, etc., negligently and repeatedly, through many months and even years, deposits the same near the residence of citizens on land belonging to a nonresident, instead of on the dumping ground provided by the city beyond its corporate limits, it was held immaterial that the land so made the dumping ground of the city was not under the control and did not belong to the city. City of Stephenville v. Bower, 29 Tex. Civ. App. 384.

In Lane v. Concord, 70 N. H. 485, an action against a municipal corporation for creating a nuisance by dumping refuse material upon a vacant lot adjoining the plaintiff's premises, it was incumbent on the plaintiff to establish that the municipality committed the acts complained of, and that such acts wrongfully injured and damaged her in her person or estate; and in the determination of the latter issue, a city ordinance prohibiting the acts complained of was merely competent evidence to be considered by the jury, in connection with all the circumstances of the case, but not conclusive.

The courts will not readily interfere by injunction to prevent the erection or operation of a plant for the reduction of garbage, unless it clearly appears that the plant is constructed or operated so as to constitute a serious nuisance. Baltimore v. Sackett, 135 Md. 56, 107 Atl. 557. A plant for the disposal of the garbage of a city being, like one for the disposal of sewage, essential to the health and comfort of the people at large, an injunction should not issue unless under very extraordinary circumstances, but the party complaining should be left to his or her remedy at law. Taylor v. Baltimore, 130 Md. 146. In a suit against the Mayor and City Council of Baltimore, a prayer asking not only that the defendants be enjoined from hauling garbage to, dumping it upon, or reducing it on a farm, owned by the city, but also from proceeding with the erection of a temporary reduction plant on the farm for the reduction of the city's garbage, and from conveying to this farm all or any portion of the garbage from the city for the purpose of being so reduced, was held too broad and general, and

the injunction was refused. Baltimore City v. Sackett, 135 Md. 56. A municipal corporation was proceeding, under contract with a crematory company, to erect an incinerator, or crematory, for the destruction of the city garbage near the business center of the city, on a guaranty by the company that the plant, when completed, would consume the garbage without offensive odors, etc. The construction of the garbage plant had proceeded to within two days of completion when an equitable petition was filed by residents living within 100 yards of the crematory to enjoin the further progress of the work because of the offensive odors, gathering of flies, etc., which it was alleged would be caused by the hauling and dumping of the garbage. It was held that, there being evidence from which the jury could find that there were other available vacant lots in a different and more remote section, away from the heart of the city and the residential section thereof, and that the hauling of the garbage near the petitioners' residences would cause flies and noxious fumes and poisonous gases emanating from the garbage to pester the petitioners and depreciate the value of their property, a verdict enjoining the completion of the crematory was authorized. Quitman v. Underwood, 148 Ga. 152, 96 S. E. 178.

Certain residents of a city living on a bluff filed a bill in equity against the proprietor of a garbage furnace situated on the river bank at the base of the bluff, complaining of annoyance by odors from the garbage before it was put into the furnace, which was of the best and most approved construction, and was operated under a contract with the city, on a site selected by the city authorities. The evidence tended to show that the site was probably the best for the purpose anywhere within, or in the neighborhood of the city. The court refused to enjoin the operation of the furnace, but decreed that the garbage should be placed in the furnace as soon as possible, and that the residuum should be shipped off as speedily as possible. The Pennsylvania Supreme Court, on appeal, Fisher v. American Reduction Co., 189 Pa. 419, held that the decree was a proper one under the circumstances.

In such cases the doctrine of contributory negligence has no application, so that it is no defense to an action against the city for permitting garbage and refuse emitting noxious odors to be dumped in a street near the plaintiff's premises that the plaintiff caused garbage and refuse to be deposited on his premises. Correll v. City of Cedar Rapids, 110 Iowa 333.

If an incinerator plant, or other garbage disposal plant, is one of the instrumentalities constructed by the city for the purpose of carrying out its legitimate powers, and is fit to be used for that purpose as a permanent structure, and the damage to adjoining real estate from noxious odors and the deposit of ashes and other offensive substances results from the construction and proper operation of the plant, the injury is a permanent one, and the measure of damages is the diminution in the value of such real estate by reason of construction and proper operation of the plant. But if the injury arises solely from the negligent or improper operation of the plant, such injury is of a temporary character, and damages therefore must be recovered in successive actions. Keene v. City of Huntington, 79 W. Va. 713.

When the deposit of garbage on land causes no permanent injury to the soil, and there is no evidence that the odors created by it will be permanent, no recovery can be had for loss on the ground of permanent injury to the property. Where the injury is not permanent, the measure of damages is the difference in the rental value of the property with and without the nuisance, with any incidental damages such as the cost of removing the nuisance and of taking care of the premises when not rented because of its existence there. City of San Antonio v. Mackey, 22 Tex. Civ. App. 145.

A complaint for damages and to enjoin the pollution of the plaintiff's fish pond, caused by dumping garbage where it polluted the stream which fed the pond, must aver that at or prior to the bringing of the suit the city allowed or permitted the refuse to wrongfully, negligently or carelessly escape from the dumping ground to the plaintiff's injury. City of Newcastle v. Harvey, 54 Ind. App. 243.

Present Status Activated Sludge Process

Brief description, from personal inspection of English and American plants. Description of experimental plant embodying new ideas recently constructed by the Illinois Water Survey Division.

In a paper prepared for the American Society for Municipal Improvements, Edward Bartow, head of the chemistry department, State University of Iowa, has summed up briefly the present status of the so-called activated sludge process of treating sewage, describing at some length the plant recently installed by the Water Survey Division of Illinois at Urbana for experimental purposes. Mr. Bartow has recently visited activated sludge installations in England as well as in this country.

The Houston, Texas, plant is the largest in the world that has been in successful actual service. It consists of aeration chambers, settling tanks, and large air compressors in a building at one end of the tanks. On a hill above the plant are buildings in which sludge pressing and sludge drying experiments are being made. The effluent obtained has been very satisfactory but no definite plan has been decided upon for de-watering and drying the sludge, which up to this time has been disposed of by lagooning.

The first plant of any size was that built in Manchester, England, in 1914, and this is still

operating on the fill-and-draw system with a daily capacity of about 50,000 gallons. As a result of experiments with this plant the city of Manchester constructed a plant on the continuous flow plan with a capacity of about 500,000 gallons. In the latter plant the sewage passes five times the length of the tanks and the sludge is returned through a pipe to the point where the sewage enters the plant. The mixed sewage and sludge passes to the center of the settling basin and the clear effluent flows out over the edges of the tank at the corners in order to prevent short circuiting. Results with this plant were so satisfactory that a much larger one has been constructed at Davyhulme where the sewage and sludge passes three times the length of the tank and the sludge returns to the entrance in an open channel having half the width of the aerating channel. For experimental purposes two kinds of settling tanks have been constructed, one for gravity separation with a bottom sharply sloped so that the sludge may settle to the center of the hopper and be removed by gravity; the other having a circular bottom sloping only slightly and a collecting mechanism to carry the sludge to the center for removal.

Worcester, England, has also been successful with a small plant and will probably adopt the activated sludge process for treating all its sewage. During the war several small plants were constructed at hospitals and munition plants. One at Blackpool takes care of the sewage from a munition plant employing 3,000 men.

In the United States most of the activated sludge plants are experimental except that at Houston. Following experiments by the Sanitary District of Chicago and by Milwaukee, both of these have adopted the process for large plants, the former having a large unit under construction at Maywood, and a large plant will be built to dispose of the waste from the stock-yards and another in the Calumet district.

Milwaukee is still endeavoring to solve the problem of sludge drying in order to decide upon the best design for the service plant for the city. The Milwaukee Sewerage Commission has spent much time and energy in an effort to solve the sludge problem and at present is experimenting with a continuous centrifugal machine which it is hoped will prove satisfactory and successful. Aside from the centrifugal machine, plate pressing seems to be most promising.

The state water survey division at Urbana with a small appropriation has established an experiment station which is being put in operation at the present time. In this it is proposed to have a plant as complete as possible. It will have approximately 100,000 gallons daily capacity and will include screening, aeration, sludge de-watering and drying.

The sewage flows by gravity through the grit chamber to a screen furnished by the Dorr Company of New York. After screening, the sewage passes to the pump pit from which the screened sewage is pumped to the aeration tanks. By use of screened sewage trouble from stoppage, which often occurs when unscreened sewage is to be handled, is avoided. The activated sludge plant itself contains two tanks 17 feet in diameter and 13 feet in depth. The sewage may pass through in series or in parallel. It is expected to use the plant in a manner similar to that used by the Dorr Company, in an experimental plant at Mount Vernon, N. Y.* About half way between the top and bottom of the tank is a tray inclined slightly upward toward the center. Air is forced in through filtros plates at the bottom and is caught and carried to the center of the tank under the tray. The air rises through the central well and is returned with the incoming sewage through another well to the lower compartment of the tank where it is carried by a revolving mechanism to the outside toward the outer rim of the bottom of the tank where it passes over the plates and is caught up by the air and carried with the air to the top, thus completing the circuit.

At the top, part of the mixed sewage and sludge passes over an adjustable collar into the upper part of the tank, which is a settling compartment. The clarified liquid passes over the outer edge into the trough from which it passes to a second tank or to a stream. The sludge is carried by another mechanism to the outside of the upper chamber and flows by gravity through down-cast peripheral wells into the lower chamber, where it is mixed with sewage and air and enters the aeration circuit.

We thus have two circuits; one for sewage, sludge and air and the other through the sedimentation section of the tank for the sludge alone. It is hoped by this method to demonstrate what was shown by the Mount Vernon test, that the amount of air used can be greatly reduced.

The two important problems of the activated sludge process which have not been satisfactorily solved are the amount of air used and the drying of the sludge. By the Dorr-Peck process, it is proposed to reduce the amount of air. Two other proposed methods should be mentioned, both English. In one it is proposed to use the air intermittently. Sufficient air will be added to saturate the mixture of sewage and sludge, then the addition of air is discontinued for a while until the air is used up. In the other, the scheme which has been adopted for the new plant at Manchester, the air comes in at one side of the long tank and is expected to cause the sewage and sludge to circulate in a direction horizontal to the line of flow through the tank. The portions of the tank at the sides farthest from the aerating plates have a curved bottom and it is expected that the circulation will be such that the amount of air required will be greatly reduced.

The other problem not satisfactorily solved is sludge drying, and it is my thought that many cities that have been considering methods of sewage disposal have hesitated to adopt the activated sludge process because of the difficulty in disposing of the sludge. Because of the expense, engineers have advised against its adoption by several cities. Where possible, if the amount of air could be decreased and the sludge satisfactorily dis-

*This was described in Public Works for January 15, 1921.

posed of, the method might be found the most satisfactory and the cheapest.

For the final drying, aside from attempts to dry the sludge on sand beds, most attempts have been made by direct-heat driers. Recently, the Bailey Mfg. Company in Milwaukee has designed an indirect-heat drier which is to be tried out at the sewage testing station at Urbana. In preliminary tests with this drier, a sludge with less than 10 per cent moisture was obtained from sludge having originally nearly 90 per cent of moisture. There was no unpleasant odor and no dust noted during the process. Drying without odor or dust has not been accomplished with direct-heat driers and it is hoped that the expense of the indirect-heat driers will not be too great and that it may solve the problem of sludge drying.

Substitutes For Sewers*

By W. A. Hardenberg

Use of septic closets, chemical toilets and small septic tanks. Comparison of annual costs of the chemical types.

THE SEPTIC CLOSET

The septic closet has been used a great deal, especially in the south in industrial and mill villages as well as in many of the smaller towns. The fact that it has not lived up to its advance notices can be charged to commercial interests very largely, though the lack of proper care and maintenance have been important items. This type has been pushed very widely by several manufacturers and in the intense competition, extravagant claims have been made and occasional shoddy work has been done.

The septic closet is also known as the L. R. S., from the initials of its originators, Drs. Lumsden, Roberts and Stiles, of the Public Health Service. Its action is generally the same as that which takes place in a septic tank. The needed water is added daily or weekly by means of buckets. The effluent passes out through an open-joint tile line and is disposed of by means of sub-surface irrigation.

The seat lid must be kept down to exclude flies; kerosene oil must be used in the summer to prevent mosquito breeding; the water must be added regularly and in sufficient quantity. If these precautions are observed, very good service is obtained from this type of installation. There is considerable odor in hot weather, and the effluent is discharged into the soil in such fashion as to promote ground water pollution, but these are really secondary considerations in comparison with the health protection that such an installation gives.

The septic closet is manufactured widely and can be bought for about $38 to $40, exclusive of the house; or most anyone at all familiar with concrete can manufacture one for himself. As the "Kentucky sanitary privy," the fame of this type has been heralded far and wide. Plans are available from almost any county or city health officers, and from all state health offices. The cost of the home-made type will average about $35.

The capacity or size of the septic closet is important. North Carolina now requires a capacity of 200 gallons minimum, and this is about as small as should be used. Of equal importance is careful installation. The disposal tile should be laid to grade and line, the tank placed level, and on a good foundation.

The septic closet is an outdoor installation, and experience has shown that these are rarely satisfactory for thickly settled communities for any great length of time. It is generally poor economy to use them in city sanitation. The fairly large first cost, though followed by low maintenance costs, is really too great in view of its temporary character.

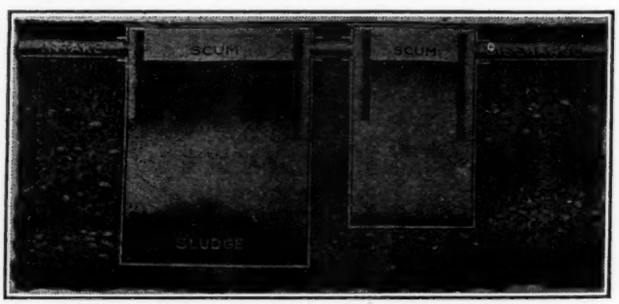
THE CHEMICAL TOILET

This outfit is built in two types, the commode, and the storage system. The former is unsuited for use in urban districts, as it is merely a metal box and can to which chemical is added. In fact, the only real field for the commode is as a convenience in the country or rural sections. The storage type is equipped to care for the sewage from a family for from four to eight months without scavenging. It has the advantage of indoor installation and is perhaps the best, though rather costly, substitute for running water.

It consists of a metal tank, protected against the action of the chemical and of sewage, a china bowl, a connecting tube and adequate ventilation. The tank is charged with a small amount of chemical—about 15 gallons of solution—which is usually caustic soda. This breaks up, deodorizes and sterilizes the sewage. The cost of operation averages about $5 per year, but the first cost is rather high, from $60 to $80. Scavenging is made easy by providing an underground pit into which the tank contents may be turned by opening a valve.

SMALL SEPTIC TANKS

Where running water is at hand, but no sewers, houses may have plumbing installed and the sewage carried to small septic tanks for treatment, as was mentioned in this magazine a short time ago in connection with Baltimore. The small septic tanks work very efficiently and will care for the sewage of the average residence with a minimum of attention and cost. Economy in first cost may often be attained by combining the flow from two or more houses and installing a larger tank.



A COMMERCIAL METAL SEPTIC TANK, RESIDENCE SIZE

*Continued from page 296.

The capacity required in these small tanks is roughly from 20 to 30 gallons per capita, but almost every state board of health has its own requirements, and these should be followed. The cost will run, for the smaller tanks, about 30 cents per gallon, and for the larger ones about two-thirds as much. Concrete tanks are used to a large extent, both built in place and pre-cast. Of late the metal tank has come into favor. Among its advantages are the ease of handling and the fact that it may be dug up and moved if desired. It is also a little cheaper than the concrete tank.

The matter of the disposal of the effluent is a very important one. Sub-surface irrigation is one of the methods applicable, but local conditions will govern this point. If metal tanks are used these may be dug up when sewers are extended to that section, and used in another place, meanwhile using the sewer from the house to the septic tank as a house connection for the sewer.

COST

A rough estimate of cost has been given along with the description of each type. To correctly estimate the cost of each method of disposal requires the consideration of first cost, annual cost, maintenance and operating expenses.

With the exception of the pit and the wooden box and can outfit, the other types described in the preceding pages are fairly long-lifed. This may or may not be an advantage, depending upon the length of time that may intervene before sewers are constructed. However, it is hardly fair to the more durable types to compare them in regard only to first cost. For that reason there is given herewith a basis of costs for a ten-year period.

Type of Disposal	Installation	Int. and Maint.	Scavenging	Total Cost	Annual Cost
Pit	$60.00	$19.80	$36.00	$115.80	$11.58
Box (wood) and can	24.00	10.02	70.00	104.02	10.40*
Concrete vault....	35.00	21.00	60.00	116.00	11.60
Commercial L.R.S.	38.50	23.10	20.00	81.60	8.16
Home-made L.R.S.	35.00	21.00	20.00	76.00	7.60
Chemical toilet....	65.00	39.00	50.00	154.00	15.40

*Does not include share of disposal expense, as purchasing land for burial, etc.

The above are on the basis of 10 years' service. In this time the pit would have to be cleaned ten times; the box and can (wooden) would have to be replaced at the end of five years with a complete new installation, as its life is only about 5 years, and the cans renewed every two years. All the other installations are durable and permanent.

The question of housing also affects the cost. In the above table, this cost for housing should be added to the cost of the pit, the box and can, the concrete vault and the L. R. S. type. The annual cost would be about $3, but this has been omitted from the table because it is often the case that the old house can be adapted for use.

To the above costs given for the septic tank, when used with running water should be the expense of putting plumbing into the home—at least $125—and the annual cost of water, $6 to $10.

The scavenging cost for the chemical toilet includes the cost of chemicals. The scavenging cost for the L. R. S. will depend largely upon the use given them. If abused, it may be necessary to clean them every 6 to 12 months. Otherwise, biennial cleanings will be sufficient. The scavenging cost for the box and can is assumed on the operation by the community of a fairly efficient and sanitary scavenging force.

When these points are all included it may very often be open to question as to whether extending the sewers may not be the cheapest way out of the situation. However, if this cannot be done—and there are many places where it cannot—any of the above methods will be a vast improvement over the lack of method usually found in the average city's unsewered area.

Non-Rigid Base for Granite Blocks

The Department of Public Works of Providence, R. I., relaid a considerable yardage of old granite block pavement, part of which had been laid originally on a six-inch cement-concrete foundation and part on a rolled broken stone base. Much of the pavement had settled in places after carrying considerable traffic. In relaying that laid on a broken stone base, the old base was replaced with one of asphalt macadam.

The first step was to take up and clean the old blocks thoroughly, no recutting being necessary. The sub-base was of gravel, varying in thickness up to 8½ inches. This sub-base was rolled thoroughly, and on top of it was placed 2-inch trap rock which was rolled to an average depth of three inches. Smaller size trap rock was spread and rolled to fill the larger voids.

This stone was then given a penetration treatment of No. 96 Texaco asphalt, using about 1½ to 1¾ gallons per square yard. Stone chips were then spread and the base was rolled. Following this, a sand cushion one inch or more in depth was spread on the asphalt macadam base, and on this cushion the granite blocks were relaid.

After the blocks had been laid and a small amount of stone chips had been swept into the interstices, the joints were filled with asphalt. Sufficient asphalt was spread so as to slightly flood the surface of the blocks for about one-third their area.

After the asphalt filler had been applied, the surface was covered with clean stone chips and rolled, after which the street was open to traffic.

The engineers in charge are thoroughly pleased with the results, and the street offers an excellent thoroughfare for heavy traffic with a minimum of noise.

Modern Road Building and Maintenance

Andrew P. Anderson, highway engineer, Board of Public Works, United States Department of Agriculture, has prepared a resume of principles and practice for the use of engineers, contractors, road officials, students and others interested in the rational and economical solution of problems connected with public roads and traffic.

The book has 146 pages besides a number of half-tones and nine drawings, is well printed in large type, is bound in stiff paper covers. It has sections on planing the road, road materials, road construction, road maintenance and repairs, and the use of explosives.

It is comprehensive and carefully written with many valuable and convenient data, with a section treating of road construction which occupies about one-half of the volume and is divided into fourteen chapters on organization and equipment, clearing and grubbing, drainage, quarrying and stone crushing, earthwork, bridges and culverts, bituminous surface application and the principal types of road surfaces, namely earth, sand-clay, gravel, water-bound macadam, bituminous, concrete and brick.

*Continued from page 296.

A COMMERCIAL METAL SEPTIC TANK, RESIDENCE SIZE

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

What Are the Advantages, Disadvantages and Uses of Limestone in Highway Construction?

Widely distributed, easily obtained, and has a large range of characteristics. Many varieties are acceptable for masonry and for concrete stone; some for macadam surface under light traffic. Has great cementitious properties, but is generally not tough or hard enough for macadam surface.

St. Louis, Mo.,
March 23, 1921.

GENTLEMEN:

As I am interested in municipal improvements I receive a great many ideas from reading PUBLIC WORKS.

Noting your ad on page 40 of your March 12 issue I take the liberty of asking for information on "The Use of Limestone for Road Construction," its advantages and disadvantages.

Any data you can give me will be greatly appreciated and I thank you for your courtesy.

Yours very truly,

* * * * *

In the United States limestone is abundant east of the Rocky mountains and its principal varieties include Chazy, Chiteau, Black River, Helderberg, Keokuk, Niagara, Onondaga, St. Louis and Trenton, most of the names indicating the locality where it is found.

The properties of limestone vary greatly with its composition and the locality in which it occurs. The compressive strength varies from 3,000 to 25,000 pounds per square inch, hardness is about 3.55 to 4 for dolomite in a scale reaching from 1 for talc, the softest, to 7 for quartz, the hardest, rocks being classed hard at 6.

In general the qualities of limestone vary greatly with its composition. The texture may be coarse or fine, it may be granular, oolitic, or crystalline, and it may be hard and compact, brittle and vitreous, well or loosely cemented or friable. There are, of course, corresponding variations in the hardness and durability, some specimens having a higher resistance to crushing and greater durability than others. It is generally lacking in the extreme hardness and toughness possessed by some other rocks, notably trap rock, but is an excellent binder for macadam road. When quarried it usually breaks into irregular fragments that, in loose heaps, have about 50 per cent voids. Broken stone for macadam and concrete can be made from the run-of-quarry or from the waste of cut stone, by crushing it in gyratory or jaw machines. The former are generally more massive and are mounted stationary, while the latter are used more for portable installations.

The broken stone is accurately graded in size from a diameter of ¼ inch to 3 inches by passing it through revolving cylindrical screens. Smaller particles, called screenings, and stone dust are saved for surface dressing of roads and have a high cementitious value. Except in a few cases where very large crushers are installed, stones of more than one or two cubic yards volume are drilled by hand, by jack hammers or by other small machines and blasted into smaller fragments easily received by the rock crushers.

At the crushing plants the broken stone is often hoisted by bucket elevators to storage bins, from which it is delivered by gravity to cars, trucks, boxes or buckets, and transferred to the concrete mixer or to other places where it is used. A complete line of mechanical plant and equipment has been developed and is on the market for quarrying, cutting, crushing, sorting, handling, storing and transporting stone for road construction and other purposes.

GENERAL USES

Limestone can be used in road construction for various purposes. Large and dimensioned pieces with rock face or hammered surfaces are suitable for ashlar or rubble masonry. When broken or crushed to diameters of 3 inches or less it is used for foundations for pavements and macadam surfaces, and for concrete.

Well-selected limestone of the harder and denser varieties is satisfactory for foundations of all sorts, bridge piers and abutments, retaining walls, culverts, arches, parapets and the like, both for rubble and ashlar work. For most of these purposes, however, concrete is used much more extensively than either coursed or random masonry and for it nearly any good quality of limestone is suitable. Its selection, however, depends on the cost and facility of production and transportation and on the relative cost, adaptability and abundance of other kinds of stone, such as granite, quartz, sandstone and other varieties. Good sound limestone is suitable for the foundation courses of all kinds of roads and pavements and under favorable conditions crushed limestone makes satisfactory wearing surface for water-bound macadam or bituminous macadam roads.

wise, biennial cleanings will be sufficient. The

road surfaces, namely earth, sand-clay, gravel, water-bound macadam, bituminous, concrete and brick.

It is, however, likely to be not sufficiently tough and durable for the wearing surface, which can generally be much more advantageously made with trap rock.

Limestone will, however, under favorable conditions, make an excellent wearing surface for light traffic and its very cementitious qualities secure a high degree of water tightness, very desirable in the road bed. Even if the limestone is too soft for the best road surface, it may be advisable to use it rather than import harder stone at a much greater cost. Dolomitic limestone is better than ordinary limestone for road surface. The presence of clay in limestone improves its road qualities and the presence of sand impairs it. A covering of iron ore on a limestone road surface greatly improves it.

Crystalline limestone is unsuitable for road surface because it has a tendency to be quickly broken and ground into dust. Calcareous limestone is also objectionable because it is to a considerable degree soluble, both in rain water and in acidulated water.

Waterbound limestone macadam roads are those in which the upper course of broken stone is compacted by the stone dust and fine particles cemented together, making a surface that, although not very durable, is attractive for light traffic, but is subject to a large amount of dust in dry weather and mud in wet weather, objections that do not obtain with bituminous macadam.

Limestone is soft and wears so unevenly that it does not make satisfactory block pavements, which in a year or two become split and worn and have to be replaced.

REQUIREMENTS AND TESTS FOR MACADAM STONE

The principal requirements for broken stone for road buildings are hardness, toughness, uniformity of wear, maintenance of rough surface, and cementing qualities. The toughness is promoted by fine grain and by the presence of quartz or hornblend. Solubility and the presence of carbonates tend to produce irregularity of wear. The maintenance of a rough wearing surface under traffic and weather conditions requires coarse grain. Durability requires hardness, toughness, sharpness and stability. Cementing qualities are generally due to oxide of iron, lime or clay.

The different qualities of limestone can be predetermined by laboratory tests of specific gravity, abrasion, impact, toughness, compression, weathering and by chemical and microscopic analysis, or they can be demonstrated by service tests in the actual road traffic.

PRACTICAL CONDITIONS

Broken stone in the macadam road surface deteriorates through the direct grinding action of steel tires, through the removal of the screenings and cementitious materials by suction and wind caused by automobile tires; by the impact and abrasion of horses' hoofs, by the grinding and breaking of pieces of stone below the surface of the road displaced by heavy pressure and concentrated loads, and by atmospheric causes, such as rain, snow, freezing and thawing.

Generally limestone is neither hard enough nor tough enough to stand abrasion and impact satisfactorily, especially under heavy traffic. This prevents it from being first-class material for waterbound macadam, but is somewhat less disadvantageous for bituminous macadam. The lack of toughness and hardness is also objectionable, although in a less degree in broken stone for concrete pavements where all the pieces are firmly held and the wear is only on the upper surface. Hard, sound limestone may be acceptable for this purpose, but is inferior to granite or trap rock.

Broken stone for road surface must, of course, conform in size to the specification, but these are likely to require for road concrete, 1½-inch stone, sometimes with the smaller pieces eliminated, but more often with them left in, so as to virtually constitute run-of-crusher with dust sifted out, thus leaving enough small fragments to fill the voids and make it as dense as possible, and increasing the strength and reducing the amount of sand, cement, and the total cost.

Macadam pavement foundation course, 4 inches or more in thickness, is made of stone usually from 1½ to 3 inches in diameter, for which good limestone containing not more than 30 per cent lime is entirely suitable.

A second course of about the same thickness is made of smaller stones, usually about 1½-inch diameter and under. This course is finished with a surface dressing of screenings or other binding material. For the top course trap rock is usually considered the best, but for light traffic the Tompkins Cove limestone, that breaks into almost cubical fragments and has great cementitious properties, or stone with similar characteristics but a different local name, is satisfactory, making a very smooth, compact road with a very pleasing surface for vehicles, but which wears rapidly.

A Workable Form of Contract*

By John Lyle Harrington

A great deal of work was let during and since the war on cost-plus-a-percentage basis, but the facts and the suspicions regarding wastefulness disclosed by the congressional investigations have led the public to be violently opposed to that form of contract at the present time. Recently I have had several clients absolutely refuse to consider such a form. It is true that the large majority of contractors are honorable business men who will carry out work under such a contract with fidelity, thoroughness and economy, but the innocent suffer with the guilty and I am afraid that for public work particularly that form will find small favor in the near future.

At the beginning of the construction of this country's public and quasi-public works the practice became established of drawing contracts entirely in favor of the owner. Some eminent engineers boasted that they always broke the contractor on their jobs and the contractor in turn took pride in skinning the job.

*Excerpt of paper presented to New Orleans convention of Associated General Contractors.

It has also been the custom of the owner to place upon the contractor, not only the responsibility for his own skill and management, which is right, but the responsibility and risk arising out of hidden conditions—floods, fires and other contingencies—and in his anxiety to secure the work the contractor, to his cost, often minimized these risks in making up his bid. I think the time has come, however, when the owner must share those elements of cost which cannot be foreseen, such as foundation conditions which are not fully disclosed by the borings, loss from flood and fire.

COST-PLUS-A-FEE CONTRACT

Early in the war period we worked out a form of cost-plus-a-fee contract which has been giving satisfaction to both parties. The specifications clearly define what shall be included in the cost estimate and what in the fee, and give an approximate estimate of quantities. The contractor then presents an estimate of cost, a bid fee, unit prices to be applied to the actual quantities in order to correct the estimated cost when the work is done, a statement of his experience, of his organization, of his equipment, and his financial ability, and the work is let to the contractor whose total estimated cost, plus his profit fee, amounts to the smallest bid, provided he is possessed of the experience, the organization, the equipment and the financial ability to carry out the work. If the corrected estimated cost, made up when quantities are known, is exceeded by the actual cost, each party bears one-half the excess cost until two-thirds of the contractors' profit fee are absorbed; the remaining one-third being considered substantially sufficient to cover certain items which enter into his profit fee. If the corrected estimate cost be less than that used in the bid, each party shares the saving.

This form provides the same character of incentive for efficient and economical work that would be present in a straight unit price contract, though its extent is diminished and so far it has worked out very satisfactorily though it places more labor upon the engineer.

Engineers and Contractors*

I think I know of one way in which the engineer can be very helpful to himself, his clients and to the contractor (and avoid the bad influence of the lawyer)—and this is to make these investigations very complete, to remove doubt and uncertainty to the greatest extent possible, that they shall draw contracts that will provide payment of items for any part of the work that can be reasonably segregated.

You know, it is quite the habit to set forth the main items of the contract and then for all minor things to say that they are included in the payment of the other items of the contract. I don't think that is fair, I don't think it is necessary, and the only excuse for using contracts of that sort is either laziness or incompetence on the part of the engineer. Also the work under each item, how it is to be measured and paid for; provide a reasonable elasticity.

This is sometimes very difficult because under some legislation and rules it is not allowable to put in the contract any provision for doing the so-called extra work or work which could not by any means have been foreseen when the contract was drawn. That is, I believe, wrong, but one must follow the law and there are still ways of getting around that difficulty. But the work upon which no direct payment is made, but includes the other items of contracts, should be reduced to a minimum.

Lastly, the difficulties surrounding the work should be set forth as clearly as possible, either in the contract document itself or by the engineers in charge of the work, at the time the contractor looks it all over with the view of bidding. Believing that the contractor on public work is just as much a partner in the undertaking as the engineer representing the governmental authority, an effort should be made to establish better working basis between the engineer and the contractor, working together to bring about a more perfect result and this in the end will reduce expense and litigation.

I heard a man say of a contract to-day, "Well, that's a pretty tough job, but that man S——— is so very thoughtful that whenever he asks me to do anything, I'll be d——— if I don't do it!"

Co-operation will bring about a feeling of that kind. In order that the elements of doubt and uncertainty attending most forms of contract work may, to the greatest extent possible, be eliminated, it should be the aim to make preliminary investigations as complete as possible and prepare plans and specifications as complete and definite as the best thought can make them, which will give all available and certain information so that the contractor can prepare an intelligent bid and accurately estimate the business risk involved.

All this would, in my judgment, stimulate competition, bring better and fairer prices and ultimately secure a more satisfactory result and greater economy.

*From address by J. Waldo Smith before Associated General Contractors.

Masonry Structures

This book by Frederick P. Spalding, professor of Civil Engineering, University of Missouri, is designed to briefly present the fundamental principles involved in the design and construction of masonry structures. It outlines early and modern development with a complete review of lime, hydarulic cement, cement specifications and tests, sand mortar and gypsum plasters.

The qualities and production of building stone, construction of stone masonry, its strength, measurements and costs are presented. Building bricks, terra cotta, gypsum and brick masonry are also discussed. The discussion of concrete includes aggregates, proportioning, mixing, placing, strength, durability, permeability and cost of plain concrete and the general principle, designs, formulas and tables for reinforced concrete beams, slabs and columns.

Analysis and classifications are given of retaining walls, straight and curved dams, slab and girder bridges, arches, culverts and conduits, and foundations with principles of design and computation, graphical and mathematical analyses, requirements of loading and service and construction methods and auxiliaries including sheeting, piling, open and pneumatic caissons, dredged caissons, and various other practical features of the work.

Recent Legal Decisions

ENGINEER PROPERLY EMPOWERED TO SEE THAT SEWER PROPERLY CONSTRUCTED—PUMPING STATION FOR SEWAGE SUBJECT FOR SPECIAL ASSESSMENT

In proceedings by a city to confirm a special assessment to pay the cost of a sewer district, objected to by owners of property, it was held, City of Nokomis v. Warsing, Illinois Supreme Court, 129 N. E. 71, that the ordinance providing for the creation of the district was not subject to the objection that it vested in the engineer a discretion as to the manner in which the improvement should be constructed or as to the material used. It described the improvement and the kind of materials to be used. Only supervisory powers were given the engineer in seeing that the work and materials were in accordance with the requirements of the ordinance. This was held not improper. The same court has held, Geyer v. City of Rock Island, 215 Ill. 144, 74 N. E. 105, that giving the engineer discretion to make a small change in some respects will not render the ordinance invalid. The ordinance provided for a pumping station for sewage, and it was claimed that this is not a local improvement, and cannot be constructed by special assessment. The Illinois court has held otherwise in Fisher v. City of Chicago, 213 Ill. 268, and Drexel v. Town of Lake, 127 Ill. 54.

PROOF OF ACCEPTANCE BY MUNICIPALITY OF DEDICATED STREETS

The New York Court of Appeals holds, Johnson v. City of Niagara Falls, 129 N. E. 213, that streets and roads dedicated by individuals to public use but not adopted by the local public authorities or declared highways by statute are not highways within the meaning of the highway acts; and there is no law by which anyone can be compelled to keep them in repair. The mere fact that a portion of the public have traveled over a road for 20 years would not make it a highway; but the use must be like that of highways in general, and the road must not only be traveled upon, but it must be kept in repair, taken in charge and adopted by the public authorities. People v. Underhill, 144 N. Y. 316, 39 N. E. 333. An intention by city authorities to accept a lane north of certain railroads in a city without formal action should not be presumed where the city has accepted land south of the railroads by specific and formal action. Isolated acts of the street department in filling holes in the claimed street are insufficient to show acceptance by the city, and the mere filing with the assessors by the owner of land of a map showing a street thereon is wholly immaterial on the question. The mere assessment by assessing officers of lands which they describe as being on a so-called street named by them is no evidence of a proper acceptance of such so-called street. And the mere omission of a municipality to assess land dedicated by the owner for a street is not alone sufficient evidence to sustain a finding of an acceptance by the municipal authorities of such land as a public street.

AUTHORITY TO MAINTAIN WATER WORKS INCLUDES POWER TO SUBSTITUTE ELECTRIC FOR STEAM PUMPING PLANT

The purpose of the Arkansas statute, Kirby's Dig., Par. 5675, authorizing a city to operate and maintain water works constructed by improvement districts, was to authorize the city council, after the water works had been constructed and turned over, to perpetuate the same by having the city maintain it up to a standard of efficiency. This would necessarily involve the repair of the plant and the renewal of parts which became worn out and in disrepair. There is nothing in the language which compels restriction of the repairs to a reconstruction in identical form in which the water works were originally constructed. Looking at it from a practical standpoint, what the statute requires is that the water works shall be kept up to the established standard, and that the city shall have control over it to determine in what way that standard of efficiency shall be maintained. The Arkansas Supreme Court holds, Arkansas Light & Power Co. v. City of Paragould, 225 S. W. 435, that the city's authority under the statute gives it power to contract for the installation of an electric pumping plant in place of the original steam pumping plant, which was not to be sold, but was to be retained as an emergency plant. The fact that such a contract based the compensation on the current rates charged for the water does not invalidate the contract as a restriction on the city's right to change its rates, the contract having been made with relation to that right; and the power company with which the contract was made could not object to a change of rates unless it was deprived of reasonable compensation.

MATERIALMEN'S RIGHT OF ACTION ON PUBLIC WORKS CONTRACTOR'S BOND

The right of action provided by the Florida statute, Chap, 6867, Laws of 1915, in behalf of any person, firm or corporation supplying labor or material to a contractor or sub-contractor engaged in the construction of public works is secured only when a bond of the contractor is filed containing the additional obligations required by the statute that the contractor or contractors shall promptly make payment to all persons supplying him or them with labor and material in the prosecution of the work provided for in the contract. A bond filed which does not contain such obligation, but does contain a condition that he will carry out all the terms of the contract, which contract contains a clause that the contractor will pay all just claims for materials and supplies that may be incurred by him in the performance of the work, is not such a bond as is required by the statute to protect third persons from whom the contractor or sub-contractor may obtain materials or labor, and no right of action is secured to such persons against the contractor and his sureties thereby.—J. B. McCrary Co. v. Dade County, Florida Supreme Court, 86 So. 612.

*From address by J. Waldo Smith before Associated General Contractors.

NEWS OF THE SOCIETIES

Apr. 25—CHICAGO SECT., AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with ELECTRICAL AND MINING SECTIONS WESTERN SOCIETY OF ENGINEERS and ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS.

Apr. 27—AKRON SECT., AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Engineering Society of Akron.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

Apr. 27-29—BUILDING OFFICIALS CONFERENCE. Cleveland, Ohio.

Apr. 27-29—SOCIETY OF INDUSTRIAL ENGINEERS. Milwaukee, Wis.

April 27-29 — UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

Apr. 27-29—BUILDING OFFICIAL'S CONFERENCE. Seventh annual meeting. Cleveland, Ohio.

Apr. 28-29—MID-CONTINENT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Chemical Eng. Societies. City Auditorium or Convention Hall, Tulsa, Okla.

Apr. 29 — ST. LOUIS SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. American Hotel

Apr. 29—NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual meeting, Detroit, Mich.

April 29 — EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

April 29 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

April 29—SAN FRANCISCO SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 2-4 — MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.

May 4-7 — NATIONAL FOREIGN TRADE CONVENTION. 8th convention. Cleveland, Ohio.

May 5 — BALTIMORE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with the Engineers Club of Baltimore.

May 5 — ROCHESTER SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint dinner of the professional engineers of Rochester. Powers Hotel.

May 6 — VANCOUVER SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 9 — HARTFORD BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Get-together dinner at City Club.

May 9-11 — AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-12 — SOUTHWEST WATER WORKS ASSOCIATION. Shirvin Hotel Headquarters, Oklahoma City, Okla.

May 10-12 — CANADIAN GOOD ROADS ASSOCIATION. 8th annual convention. Halifax, Can. Secretary George A. McNamee, Montreal.

May 17 — CLEVELAND SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual dinner.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 18—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual business meeting. Southern Club.

May 19—EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 370th meeting. Engineering Societies Building, New York City.

May 20 — PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual dinner, Hotel Adelphia Roof.

May 21 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with ATLANTA SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular meeting on April 6, Major-General John A. Lejeune, Commandant, U. S. Marine Corps, Washington, D. C., delivered an address, illustrated by moving picture diagrams on "The Battle of Meuse-Argonne."

Gen. Lejeune was commander-general of the Second Division of the American Expeditionary Forces in France, and participated in the St. Mihiel offensive, the battle of Mont Blanc Ridge (Champagne Sector, with the Fourth French Army), and the battle of Meuse-Argonne, in which his division co-operated with the Fifth French Army Corps. For conspicuous service in these battles, Gen. Lejeune was honored by the French government with the decorations of Commandeur, Legion d'Honneur, and Croix de Guerre with Palms, and was awarded the Distinguished Service Medal by Gen. Pershing and by the U. S. Navy. He participated in the occupation of Coblenz, Germany, and after his return to this country succeeded Gen. Barnett as Commandant of the U. S. Marine Corps.

FEDERAL HIGHWAY COUNCIL

Mr. S. M. Williams, chairman of the Federal Highway Council, announces the election of four new members to the executive committee of the council: Mr. W. J. L. Banham, general traffic manager, Otis Elevator Co.; Mr. David Beecroft, president, Society of Automotive Engineers and directing editor, Class Journal Co.; Colonel H. W. Alden, vice-president, Timken-Detroit Axle Co.; and Mr. S. P. Leeds, president, Atlantic City Chamber of Commerce.

Mr. Williams states that the selection of these men is in recognition of their interest and activities in the work of the Federal Highway Council, and the determination to place the work upon the broadest lines and under the direction of men of the widest experience.

AMERICAN ASSOCIATION OF ENGINEERS

The seventh annual convention of the American Association of Engineers will be held at the Hotel LaFayette, Buffalo, N. Y., on May 9, 10 and 11. The program for the first day includes the appointment of special committees, reports of officers and standing committees, and the report of judges of the election of officers which is now in progress. A discussion of chapter activities in practice by F. H. Newell, director of field forces of the association, will be followed by committee and council reports on employment, railroads, industries, federal, building and insurance trustees, salaries of engineers in public service and teaching service, education, services and fees of practicing engineers, legislative, chapter activities, municipal problems, water power and conservation, relation to foreign engineers, balloting, and organization. A smoker and entertainment will be held in the evening.

On May 10 the report of the committee on revision of constitution and by-laws will be received and discussed. In the afternoon a trip to Niagara Falls will be made.

The discussion and voting on amendments to the constitution and by-laws on the morning of May 11, a preferential voting to determine the next convention city, a report of the resolution committee and the convention will adjourn. In the evening will be held the annual dinner and installation of officers.

The election of national officers, which is now in progress and counting the votes of the 25,000 members will be accomplished at this election by having each man make his vote on a card ballot which will be punched and counted in a mechanical electrical tabulating machine.

The expenses of delegates to the annual convention of the association are paid by various chapters and it is certain that a representative gathering will be present.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION

The National Highway Traffic Association will hold its 1921 convention at the Detroit Athletic Club, Madison and John R streets, Detroit, on Friday, April 29. Sessions will begin at 10:30 a. m., 2 p. m. and 8 p. m. The convention will be devoted to the presentation and discussion of progress or final reports of standing committees. The following list includes some of the important subjects pertaining to traffic regulations and efficient and economic highway transport which have been assigned to committees:

Interrelationship of Highway, Railway and Waterway Transport, Traffic Limit Lines on Roadway Surfaces; Design of Curves at Street Corners to Facilitate Traffic; Widths of Roadways and Sidewalks in Municipalities; Highway Transport Clearing Houses, Regulations Covering Speeds, Weights and Dimensions of Motor Trucks and Trailers, Relative Efficiency of Different Types of Car Stop Safety Zones and Their Relation to Parking and Ranking Regulations, Regulation of Overloading of Motor Trucks, Traffic Center Lines on Roadways, Relation of Impact Forces on Pavements to Resulting Impact Forces on Vehicles, Status of the Construction of Highway Curves and Recommended Practice to Increase Safety to Traffic, Highway Transport Franchises, Motor Bus Service for Consolidated Rural Schools.

AMERICAN ENGINEERING COUNCIL

A communication from J. Parke Channing, of New York, chairman of the American Engineering Council's

Committee on Public Affairs, also acting for the American Society of Civil Engineers, the American Association of Engineers and the American Institute of Consulting Engineers, has been placed before President Harding recommending that an engineer be placed on the Interstate Commerce Commission, with other recommendations for appointments to the three vacancies. A supplementary communication was also submitted to the President, naming six engineers with qualifications for this appointment.

The American Engineering Council's Committee on Procedure has appointed L. W. Wallace, executive secretary of the council, as its representative on the U. S. Board of Surveys and Maps. Members of the Advisory Council of the board have been urging the American Engineering Council to aid them in obtaining an adequate program involving a larger appropriation for topographic maps.

PERSONALS

Houser, W. H., has recently been elected city engineer of Blue Springs, Neb.

Reppert, Charles M., a consulting engineer of Pittsburgh, has been appointed chief engineer of the department of public works of that city.

Claflin, F. N., formerly construction engineer for the Superior Portland Cement Co., at Concrete, Wash., is now at Anchorage, Alaska, where he will have charge of the engineering work on the construction of a large coal washing plant for the government.

Place, Arthur H., is engineer in the Bureau of Government Research at Detroit, Mich.

Hatt, William K., professor of civil engineering of Purdue University, who was appointed chief of the division of engineering of the Indiana State Department of Conservation by the State Conservation Commission with the approval of Richard Lieber, director of the Conservation Department, took office on April 11. He will continue as a member of the Purdue University faculty during his term of office.

Shirley, Henry C., will accept the position of road and sanitary engineer of Baltimore county, with headquarters at Towson, Md.

Diehl, George C., has been re-appointed county engineer of Erie county, with headquarters at Buffalo, N. Y.

Moss, Earle B., has been appointed to the newly created office of appraiser in the Bureau of Assessment and Taxation, Niagara Falls, N. Y.

McLean, J. C., has been appointed county engineer of Woodbury county, Iowa.

Lukesh, Lieut.-Col. Gustave, has been confirmed as a member of the Mississippi River Commission.

White, Glenn S., has been appointed city engineer of Fort Morgan, Colo.

Hemstead, H. J., has been assigned to District 9, U. S. Bureau of Public Roads, with headquarters at Troy, N. Y., where he will be engaged in the inspection of post road projects.

Grant, Chief Robert H., has been reappointed head of the fire department at Beverly, Mass.

Johnson, Herbert, of Kitchener, Ont., has been retained by the Village of Elmira to take charge of the construction of pavements.

Coutts, George, formerly good roads engineer for Bertile, Man., has been appointed assistant engineer, Trent Canal, Dept. of Railways and Canals, Peterboro, Ont.

Stewart, John H., town engineer of Renfrew, Ont., has been appointed town assessor, and will henceforth perform the duties of both offices.

Hawes, J. H.; Irwin, Hydnman; McGinnis, J. M.; and Lumdsen, Hugh A., have been appointed as district engineers, Ontario Dept. of Public Highways, to supervise the construction and maintenance of county and township roads, under the direction of R. C. Muir, chief engineer of county roads.

Cook, August D., president and founder of A. D. Cook, Inc., Lawrenceburg, Ind., manufacturers of deep well pumps and strainers, died on March 28, 1921.

Heaur, Albert R., was elected president and Peters, R. J., re-elected clerk of the village of River Rouge, Mich.

Dibble, Fred B., was elected president and Dysarz, Leonard, clerk of the village of Hamtramck, Mich., at a recent election.

Affleck, W. L., has commenced his duties as city engineer of Nelson, B. C.

Baird, John A., city engineer of Sarnia, Ont., has resigned.

Blue, Malcolm, of St. Thomas, has been appointed road superintendent of Dunwich township, Ont.

Brian, M. E., city engineer of Windsor, Ont., has been appointed road commissioner of the Windsor suburban area.

Meyers, A. J., formerly chief draughtsman for the Quebec Bridge Board of Engineers, has been elected mayor of Campbellford, Ont., and a member of the Water and Light Commission.

INDUSTRIAL NOTES

AMERICAN SPECIFICATION INSTITUTE

The American Specification Institute was permanently organized on March 18. The first board of governors consists of the following members: Chairman, Ralph W. Yardlye; executive secretary, Gardner C. Coughlen; other members, C. L. Post, Frank A. Randall and A. T. North. Organization headquarters have been established in Chicago.

NEW ENGINEERING FIRMS

Johnson & Benham, Inc., consulting engineers, of New York and Kansas City, Mo., announce the reorganization of the business. All contracts and business of the New York office have been taken over by George A. Johnson Company, Inc., the members thereof being George A. Johnson, Harold C. Stevens, Nelson B. Wolfe, Charles R. Wyckoff and Harry B. Joyce. The main offices of the corporation are at 150 Nassau street, New York City. All contracts and business of the Kansas City office have been taken over by Benham & Mullergren, a partnership consisting of Webster L. Benham and Arthur L. Mullergren, with offices on the eighth floor, Firestone building, Kansas City, Mo.

The Mid-West Engineering Co., Coffeyville, Kan., has been organized by G. A. Barcroft, assistant construction engineer of the Sinclair Refining Co., and other engineers of experience, and will engage in general engineering practice, including buildings, power development, water dams and reservoirs, surveys, maps, estimates, designs and investigations.

E. F. Pegg, who has been connected with manufacturers of contractors' equipment in Cleveland and vicinity for a number of years, has opened an office in Cleveland for the purpose of handling contractors' equipment.

Morrison & Risman Co., of Buffalo, N. Y., jobbers in new and relaying rails and accessories, has opened an office in Philadelphia, Pa., with R. B. Morrison as district manager.

The Stearns Conveyor Co., Cleveland, Ohio, has been organized by Earl D. Stearns, formerly of the H. K. Ferguson Co., Cleveland, Ohio, and will handle elevating, conveying, screening, transmission machinery and accessories.

Greene, H. S., has been elected vice-president in charge of sales for the Barber-Greene Company, Aurora, Ill.

Puff, C. F., Jr., assistant engineer, Bureau of Highways, Philadelphia, has been appointed secretary and general manager of the Associated Pennsylvania Highway Contractors, office 200 North 3d street, Harrisburg, Pa.

The Meriwether Pressure Pipe Co. has been incorporated with offices at Louisville, Ky., to manufacture reinforced concrete water pipes.

Drifting Sand Filters, Ltd., with headquarters at Toronto, Ont., has been incorporated at Ottawa, Ont., to take over the Canadian patent rights of the John VerMehr Engineering Co., and to promote drifting-sand filters.

The Austin Machinery Corp. of Louisiana, Inc., is sole distributor for Louisiana, Arkansas, Mississippi and Tennessee for the products of the Austin Machinery Corp.

H. C. Nutting, manager of the Pittsburgh Testing Laboratory, Cincinnati Ohio, for the past six years, has recently organized a new company under the name of H. C. Nutting Co., at Hunt and Broadway, Cincinnati. Mr. Nutting is highway engineer of the Cincinnati Automobile Club and will specialize in highway inspection.

The Brown Hoisting Machinery Co., of Cleveland, Ohio, announces the opening of a southern office, to be located at 530 Whitney-Central building, New Orleans. The state of Texas, Louisiana, Mississippi, Alabama, Georgia and Florida will be covered from this office.

Charles H. White, manager of the new office, has been with the Brownhoist company for a number of years, and is an experienced sales engineer on all types of Brownhoist products. Among these are locomotive cranes, buckets, electric hoists, trolleys and a wide range of cranes and hoists.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

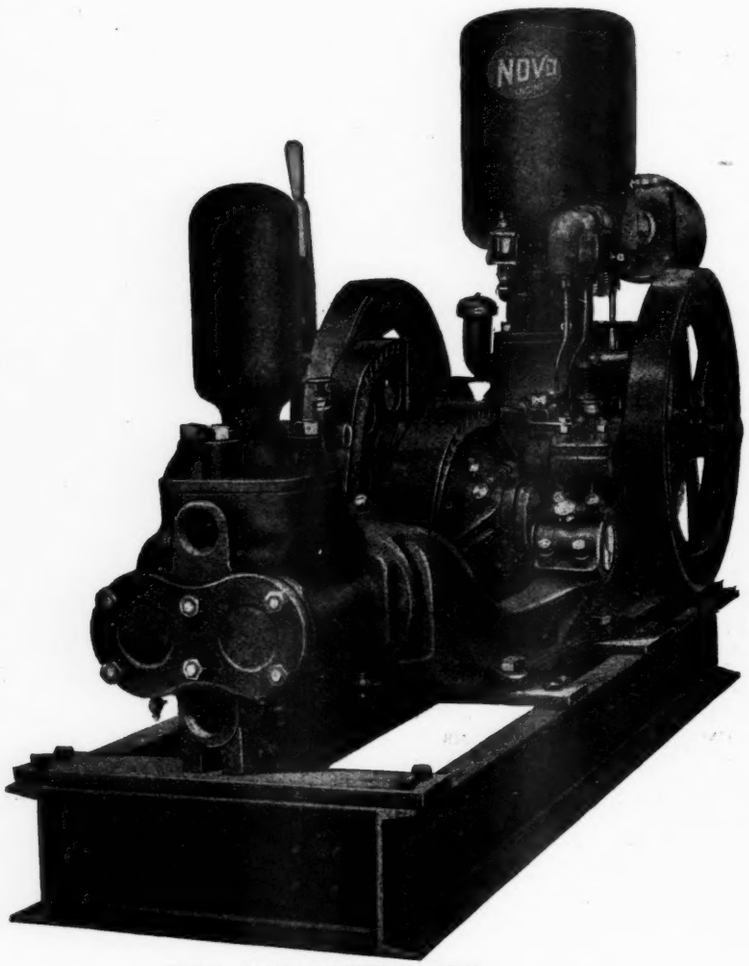
NOVO HIGH PRESSURE PUMPING OUTFIT

The high pressure pumping outfit manufactured by the Novo Engine Co. claims excessive size, durability and efficiency for high pressure work. The type U is made in 5 sizes, 1½ to 6 h. p., with capacities of 16 to 36 gallons per minute pump displacement, with maximum working pressures of 100 to 200 pounds, and weights of 225 to 1,240 pounds.

Type U, with clutch equipment, is made in 5 sizes of 8 to 10 h. p., with capacity of 60 to 100 gallons per minute pump displacement made with maximum pressure of 100 to 135 pounds and weights of 2,500 to 2,800 pounds. One size of each kind of the type U machines is especially adapted for furnishing water supplies for road construction.

The new type W double acting duplex pumping outfit is suitable for all around pumping purposes and especially adapted to furnish water suplies for road construction. It is furnished in 6, 8 and 10 h. p. sizes with capacities from 20 to 50 gallons per minute under pressures of 150 to 300 pounds. The type W consists of a double acting duplex pump and a standard Novo engine mounted together on a steel channel base, making rigid unit with a contracting band friction clutch for disconnecting the pump when starting the engine. When the crank is set at 90 degrees the pressure strokes overlap so that a continuous stream of water is supplied, thus reducing the water hammer in long pipe lines. The unit is made in 5 sizes of from 6 to 10 h. p., with capacities of 30 to 45 gallons, pump displacement per minute and maximum pressure of 150 to 300 pounds and weighs 3,750 to 5,400 pounds. The 8 h. p. unit has 2-inch suction and discharge pipes, capacity of 45 gallons at 200 pounds pressure, and is especially recommended for road construction work.

The Novo high pressure triplex pumping outfits are self-contained units with a three-throw crank shaft giving continuous and uniform action and an easy flow through the delivery pipe. It is made in 7 sizes of 4 to 15 h. p. with capacities of 80 to 125 gallons per minute, pump displacement, under pressures of 150 to 250 pounds and weighs 1,225 to 5,300 pounds. The 8 h. p. unit with 2-inch suction and discharge pipes and a capacity of 45 gallons at 150 pounds pressure, is recommended for road construction.

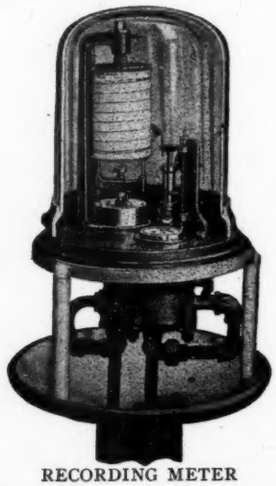


NOVO HIGH PRESSURE PUMP

METER

The recording rate-of-flow meter manufactured and sold by the Pittsburgh Filter & Engineering Company gives a direct-reading seven-day chart, and furnishes records of pumping and consumption.

The device consists substantially of a combination of a special Venturi meter with a controlling device operated by the different pressures of the approach and throat of the Venturi meter and equipped with a pilot valve regulating the proportional flow diverted to the Venturi tube.



RECORDING METER

This controlled proportional flow is delivered to the indicating, integrating and recording rate-of-flow meter, which gives a weekly record of the rate of flow and also registers the total flow automatically on a chart drum driven by clockwork and provided with a pen raised and lowered by the integrating meter. The operation of the mechanism is described in the circular, which also gives examples of seven-dav direct-reading chart.

NEW PAVEMENTS AT HALF THE COST

Under this title the Barber Asphalt Paving Company has issued an illustrated pamphlet describing the method and operations of resurfacing highways with a macadam base or with a concrete foundation. It also describes the methods of resurfacing a brick pavement with or without removing the bricks, for resurfacing a granite block pavement with concrete base without removing the blocks, and for resurfacing a wood block pavement after removing the blocks and the sand cushion below them.